total U via a total U analytical method, filtered sample, and unfiltered sample). Before trends were calculated, for each well where this applied, these multiple results were winnowed to a single result representing each unique date. Factors evaluated in selecting the result for statistical use included:

- Filtration status;
- Validation qualifiers;
- Lab qualifiers; and
- Other U results from the well.

Because most samples were field-filtered, where both sample results are provided, the filtered result is typically preferred for reasons of consistency. Similarly, where two very different results are presented, the result closer to others from the well is retained; if the two results are similar, the higher-concentration one is retained, to be conservative.

Data from original wells are grouped with those from replacement wells to form a data set on which the statistics are based. As additional data are collected from replacement wells, most of which were installed in 2005, this may prove to be inappropriate given that the data populations from original and replacement wells may be discontinuous, which suggests that data from the original wells should be removed from statistical assessments of the groundwater data. This determination will be made as the post-closure data set becomes large enough to allow such an evaluation. Therefore, it should be stressed that trends calculated for replacement wells may be misleading in that they may be strongly affected by well replacement and do not reflect only groundwater geochemistry and hydrology.

3.1.2 Routine Monitoring

3.1.2.1 POC Monitoring

This objective deals with monitoring discharges from the terminal ponds into Woman and Walnut creeks and streamflow at the additional POCs downstream at Indiana Street to demonstrate compliance with RFLMA surface-water-quality standards (see RFLMA Attachment 2, Table 1). Water-quality data at POCs are reportable under RFLMA when the applicable compliance parameters are greater than the corresponding Table 1 values (see Appendix D). Terminal pond discharges are monitored by POCs GS11, GS08, and GS31. Walnut Creek is monitored at Indiana Street by POC GS03. Woman Creek is monitored at Indiana Street by POC GS01. These locations are shown on Figure 3–2. Sampling and data evaluation protocols are summarized in Table 3–4.

Table 3–4. Sampling and Data Evaluation Protocols at POCs

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS01	Woman Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 25–35 per year)[a]	total Pu, Am, and U isotopes[b] [TSS[d]]	See Figure 5 in Appendix D
GS03	Walnut Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 20–35 per year)[a]	total Pu, Am, U isotopes[b], and nitrate[c] [TSS[d]]	See Figure 5 in Appendix D
GS08	Pond B-5 Outlet	Continuous flow-paced composites; frequency varies (target is 0−15 per year)	total Pu, Am, U isotopes[b], and nitrate[c]	See Figure 5 in Appendix D
GS11	Pond A-4 Outlet	Continuous flow-paced composites; frequency varies (target is 0−15 per year)	total Pu, Am, U isotopes[b], and nitrate[c]	See Figure 5 in Appendix D
GS31	Pond C-2 Outlet	Continuous flow-paced composites; frequency varies (target is 0−7 per year)	total Pu, Am, and U isotopes[b]	See Figure 5 in Appendix D

Notes [a]Frequency depends on available flow; samples are segregated by water origin (baseflow or pond discharge).
[b]U isotopes are U-233,234+U-235+U-238.
[c]Collected during pond discharges only; nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.
[d]Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS hold-time limits.

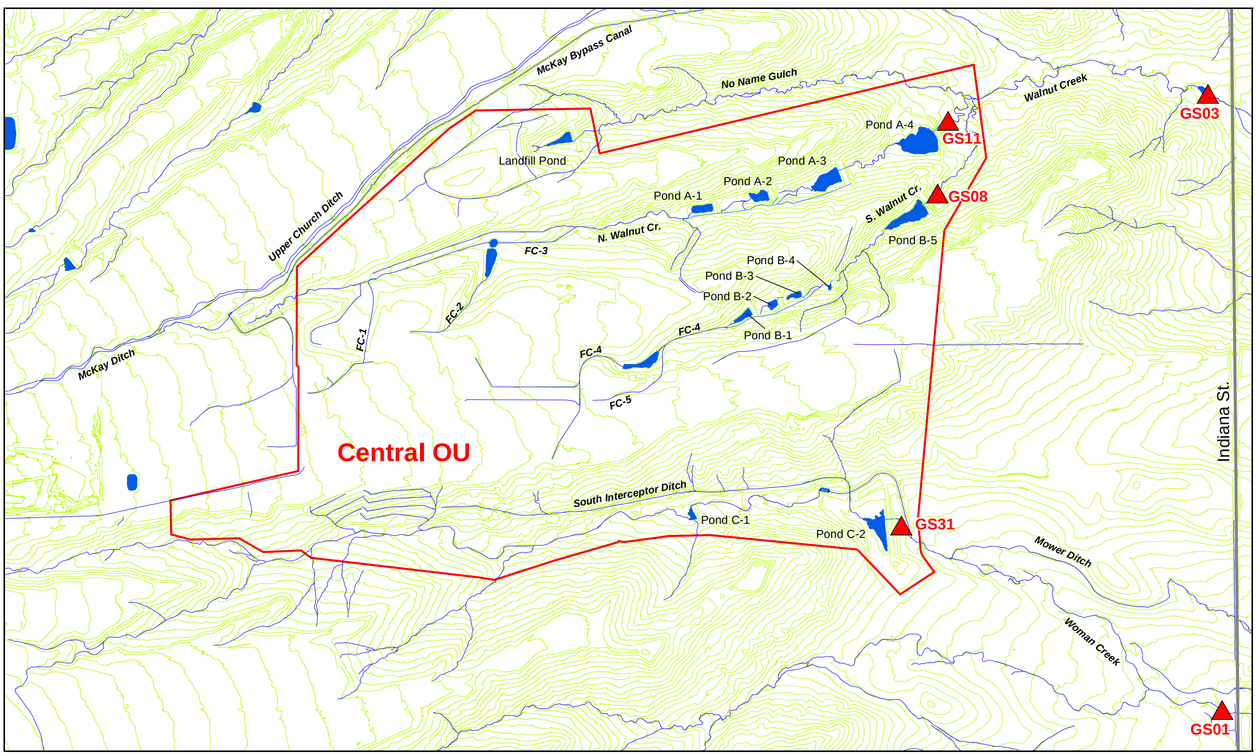


Figure 3–2. POC Monitoring Locations

The following sections include summary tables and plots showing the applicable 30-day and 12-month rolling averages for the POC analytes. The evaluations include all results that were not rejected through the verification and validation process. Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations, activities, and analytical errors are often greater than the precision presented. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the "real" and "duplicate" values. When a sample has multiple "real" analyses (Site-requested "reruns"), the value used in calculations is the arithmetic average of the multiple "real" analyses.[3]

Refer to Appendix B, which contains the water-quality data, for further information.

Location GS01

Monitoring location GS01 is located on Woman Creek at Indiana Street (Figure 3–2). The Woman Creek headwaters, the southern portion of the COU, and Pond C-2 contribute flow to GS01.

Table 3–5 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are well below 0.15 pCi/L. The average total U activities are all well below the RFLMA standard for Woman Creek of 11 pCi/L.

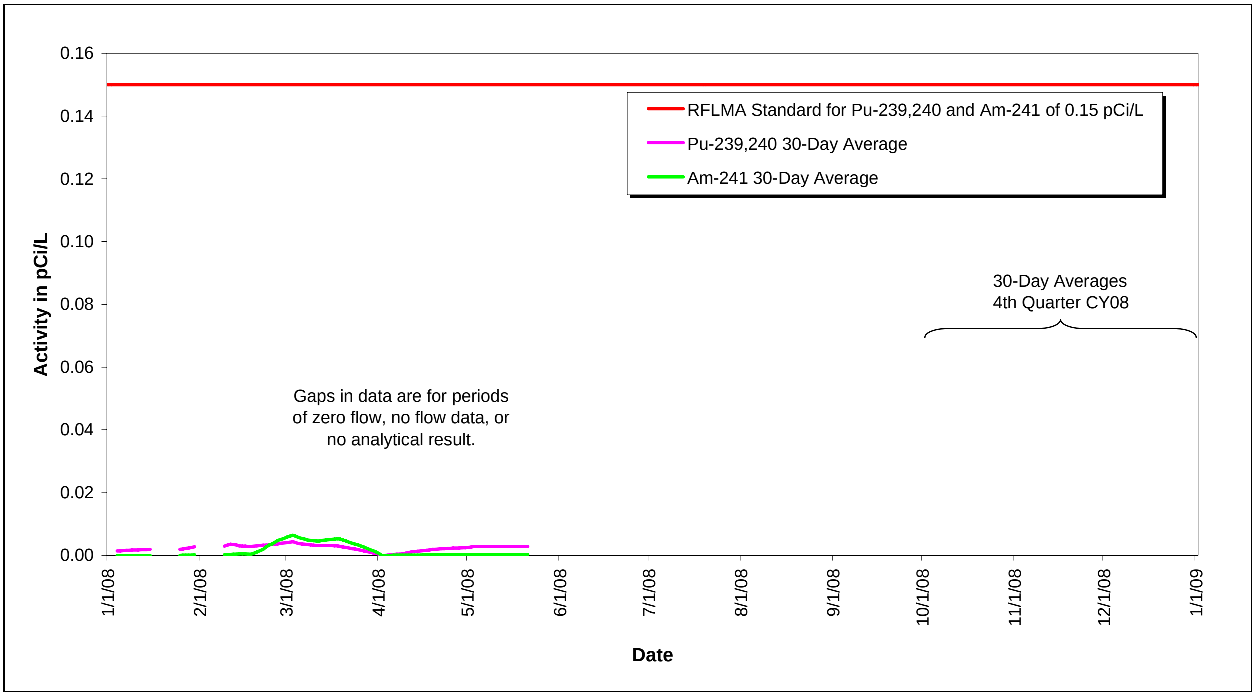
Table 3–5. Annual Volume-Weighted Average Radionuclide Activities at GS01 for 1997−2008

Calendar Year	Volume-Weighted Average Activity (pCi/L)		
	Am-241	Pu-239,240	Total U
1997	0.003	0.007	NA
1998	0.006	0.006	NA
1999	0.005	0.008	NA
2000	0.004	0.003	NA
2001	0.004	0.006	NA
2002	0.002	0.001	NA
2003	0.002	0.004	1.24
2004	0.003	0.002	3.56
2005	0.004	0.003	2.50
2006	0.012	0.003	4.76
2007	0.002	0.007	1.09
2008	0.002	0.003	4.56
Total (1997−2008)	0.004	0.006	1.75

Notes: Collection of total U data began on February 3, 2003. NA = not applicable.

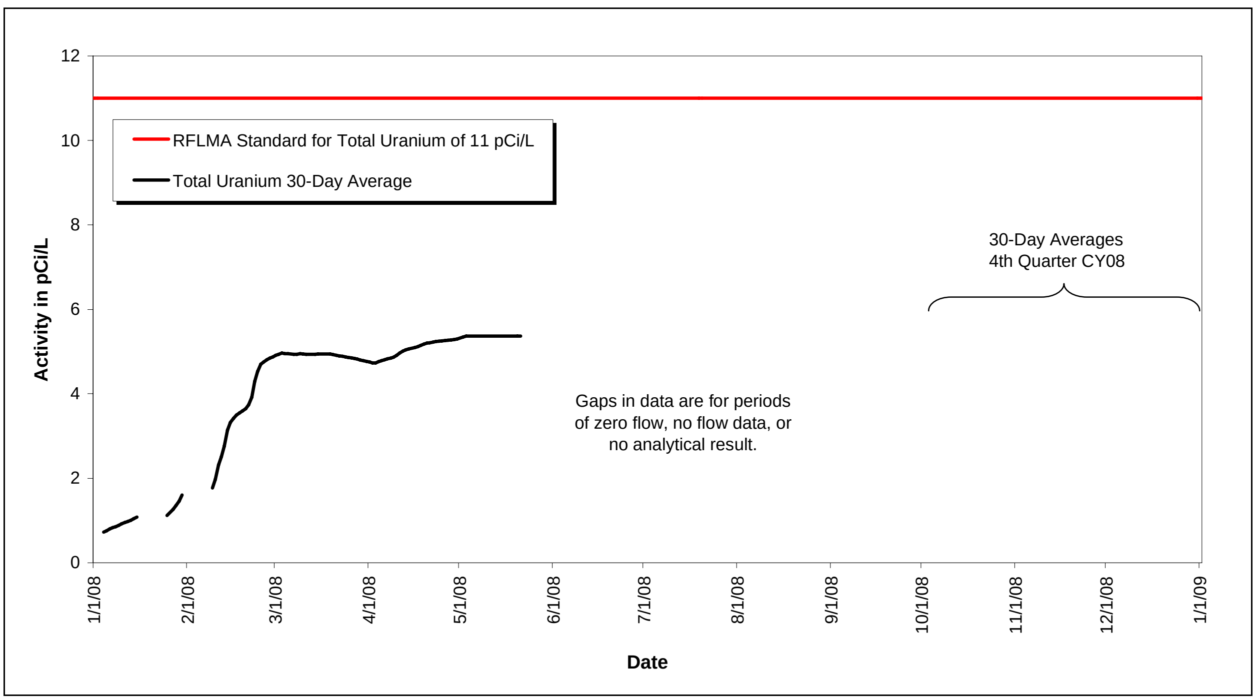
Figure 3–3 and Figure 3–4 show no occurrences of reportable 30-day averages for the year.

[3] Significant differences in values for a data pair are an indication of potential problems with sample preparation or analysis. Under these circumstances, an applicable value to be used for comparison cannot be determined with sufficient confidence to make compliance decisions. As such, an evaluation of the DER or RPD, depending on the analyte, is required to assess the representativeness of the sample and its usability for compliance decisions (see Section 8.2.3 of the RFSOG for discussion).



Note: There was no CY 2008 flow at GS01 after May 29, 2008.

Figure 3–3. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: Calendar Year Ending Fourth Quarter CY 2008



Note: There was no CY 2008 flow at GS01 after May 29, 2008.

Figure 3–4. Volume-Weighted 30-Day Average Total U Activities at GS01: Calendar Year Ending Fourth Quarter CY 2008

Location GS03

Monitoring location GS03 is located on Walnut Creek at Indiana Street (Figure 3–2). The Walnut Creek headwaters, the majority of the COU, Pond A-4, and Pond B-5 contribute flow to GS03.

GS03 did not flow during CY 2008. The last flow occurred on October 15, 2007. Therefore, no compliance values are calculated for CY 2008, and no compliance plots are presented.

Table 3–6 shows that all of the annual average Pu and Am activities were well below 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are well below 0.15 pCi/L. The average total U and nitrate+nitrite concentrations are all well below the RFLMA standard for Walnut Creek of 10 pCi/L and 10 milligrams per liter (mg/L), respectively.

Table 3–6. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS03 for 1997−2008

Calendar Year	**Volume-Weighted Average Activity (pCi/L)**			**Volume-Weighted Average Concentration (mg/L)[a]**
	Am-241	**Pu-239,240**	**Total U**	**Nitrate+Nitrite as Nitrogen**
1997	0.014	0.026	NA	NA
1998	0.010	0.014	NA	NA
1999	0.009	0.015	NA	NA
2000	0.007	0.005	NA	NA
2001	0.005	0.009	NA	NA
2002	0.006	0.012	NA	NA
2003	0.005	0.006	1.79	NA
2004	0.008	0.008	1.76	NA
2005	0.022	0.008	3.95	NA (no pond discharge after 10/13/05)
2006	NA (no flow)	NA (no flow)	NA (no flow)	NA (no pond discharge)
2007	0.002	0.006	3.76	2.34
2008	NA (no flow)	NA (no flow)	NA (no flow)	NA (no pond discharge)
Total (1997−2008)	0.009	0.012	2.42	2.34

Notes: Collection of total U data began on November 5, 2002. NA = not applicable.
[a]For pond discharge periods only; nitrate+nitrite as nitrogen sampling began on October 13, 2005.

Location GS08

Monitoring location GS08 is located on South Walnut Creek at the outlet of Pond B-5 (Figure 3–2). The central portion of the COU contributes flow to Pond B-5.

Pond B-5 was not discharged during CY 2008. The last discharge occurred during July 5−12, 2007. Therefore, no 12-month rolling averages are calculated for CY 2008, and no compliance plots are presented.

Table 3–7 shows that all of the annual average Pu and Am activities were well below 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are well below 0.15 pCi/L. The average total U activities have shown recent increases due to contributions from GS10 (see Section 3.1.2.2). Nitrate+nitrite concentrations are well below 10 mg/L.

Table 3–7. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS08 for 1997−2008

Calendar Year	Volume-Weighted Average Activity (pCi/L)			Volume-Weighted Average Concentration (mg/L)[a]
	Am-241	Pu-239,240	Total U	Nitrate+Nitrite as Nitrogen
1997	0.008	0.006	1.69	NA
1998	0.006	0.008	2.33	NA
1999	0.015	0.046	1.38	NA
2000	0.029	0.047	0.93	NA
2001	0.004	0.006	1.24	NA
2002	0.003	0.002	0.68	NA
2003	0.006	0.026	1.37	NA
2004	0.009	0.009	1.24	NA
2005	0.021	0.008	6.11	NA (no pond discharge after 10/13/05)
2006	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2007	0.002	0.003	8.45	0.38
2008	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
Total (1997−2008)	0.012	0.022	1.71	0.38

Notes: NA = not applicable.
[a]Nitrate+nitrite as nitrogen sampling began on October 13, 2005.

Location GS11

Monitoring location GS11 is located on North Walnut Creek at the outlet of Pond A-4 (Figure 3–2). The northern portion of the COU contributes flow to Pond A-4.

Pond A-4 was not discharged during CY 2008. The last discharge occurred during July 5−26, 2007. Therefore, no 12-month rolling averages are calculated for CY 2008, and no compliance plots are presented.

Table 3–8 shows that all of the annual average Pu and Am activities were well below 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are well below 0.15 pCi/L. The average total U and nitrate+nitrite concentrations are all well below 10 pCi/L and 10 mg/L, respectively.

Table 3–8. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS11 for 1997−2008

Calendar Year	Volume-Weighted Average Activity (pCi/L)			Volume-Weighted Average Concentration (mg/L)[a]
	Am-241	**Pu-239,240**	**Total U**	**Nitrate+Nitrite as Nitrogen**
1997	0.005	0.008	1.82	NA
1998	0.011	0.004	2.18	NA
1999	0.003	0.007	1.76	NA
2000	0.001	0.018	2.45	NA
2001	0.003	0.002	2.89	NA
2002	0.003	0.000	2.29	NA
2003	0.003	0.002	2.91	NA
2004	0.006	0.002	2.71	NA
2005	0.022	0.002	1.78	NA (no pond discharge after 10/13/05)
2006	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2007	0.001	0.007	3.77	3.02
2008	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
Total (1997−2008)	0.006	0.006	2.26	3.02

Notes: NA = not applicable.
[a]Nitrate+nitrite as nitrogen sampling began on October 13, 2005.

Location GS31

Monitoring location GS31 is located on Woman Creek at the outlet of Pond C-2 (Figure 3–2). The southern portion of the COU contributes flow to Pond C-2.

Pond C-2 was not discharged during CY 2008. The last discharge occurred during July 1−14, 2005. Therefore, no 12-month rolling averages are calculated for CY 2008, and no compliance plots are presented.

Table 3–9 shows that all of the annual average Pu and Am activities were below 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are below 0.15 pCi/L. The average U activities are all well below 11 pCi/L.

Table 3–9. Annual Volume-Weighted Average Radionuclide Activities at GS31 for 1997−2008

Calendar Year	Volume-Weighted Average Activity (pCi/L)		
	Am-241	Pu-239,240	Total U
1997	0.008	0.017	2.10
1998	0.018	0.003	2.53
1999	0.010	0.043	2.70
2000	No C-2 discharge	No C-2 discharge	No C-2 discharge
2001	0.013	0.021	1.25
2002	0.015	0.089	2.43
2003	0.006	0.015	1.62
2004	0.010	0.021	1.65
2005	0.008	0.020	4.07
2006	No C-2 discharge	No C-2 discharge	No C-2 discharge
2007	No C-2 discharge	No C-2 discharge	No C-2 discharge
2008	No C-2 discharge	No C-2 discharge	No C-2 discharge
Total (1997−2008)	0.011	0.019	2.13

Note: NA = not applicable.

3.1.2.2 POE Monitoring

This objective deals with monitoring runoff and baseflow from the interior of the COU to the A-, B-, and C-Series Ponds to demonstrate compliance with surface-water-quality standards (see Table 1 of RFLMA Attachment 2). Water-quality data are reportable under RFLMA when the applicable compliance parameters are greater than the corresponding Table 1 values (see Appendix D). Surface water is monitored by POEs SW093, GS10, and SW027 on North Walnut Creek, South Walnut Creek, and the SID, respectively. These locations are shown on Figure 3–5. Sampling and data evaluation protocols are summarized in Table 3–10.

Table 3–10. Sampling and Data Evaluation Protocols at POEs

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS10	South Walnut Creek at Outfall of FC-4	Continuous flow-paced composites; frequency varies (target is 20 per year)[a]	total hardness, Be, Cr, Pu, Am, and U isotopes[b]; dissolved Ag and Cd; [TSS[c]]	See Figure 6 in Appendix D
SW027	SID at Pond C-2	Continuous flow-paced composites; frequency varies (target is 14 per year)[a]	total hardness, Be, Cr, Pu, Am, and U isotopes[b]; dissolved Ag and Cd; [TSS[c]]	See Figure 6 in Appendix D
SW093	North Walnut Creek at Outfall of FC-3	Continuous flow-paced composites; frequency varies (target is 16 per year)[a]	total hardness, Be, Cr, Pu, Am, and U isotopes[b]; dissolved Ag and Cd; [TSS[c]]	See Figure 6 in Appendix D

Notes: [a]Frequency depends on available flow.
[b]U isotopes are U-233,234 + U-235 + U-238.
[c]Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS hold-time limits.
Ag = silver
Be = beryllium
Cd = cadmium
Cr = chromium
FC = Functional Channel

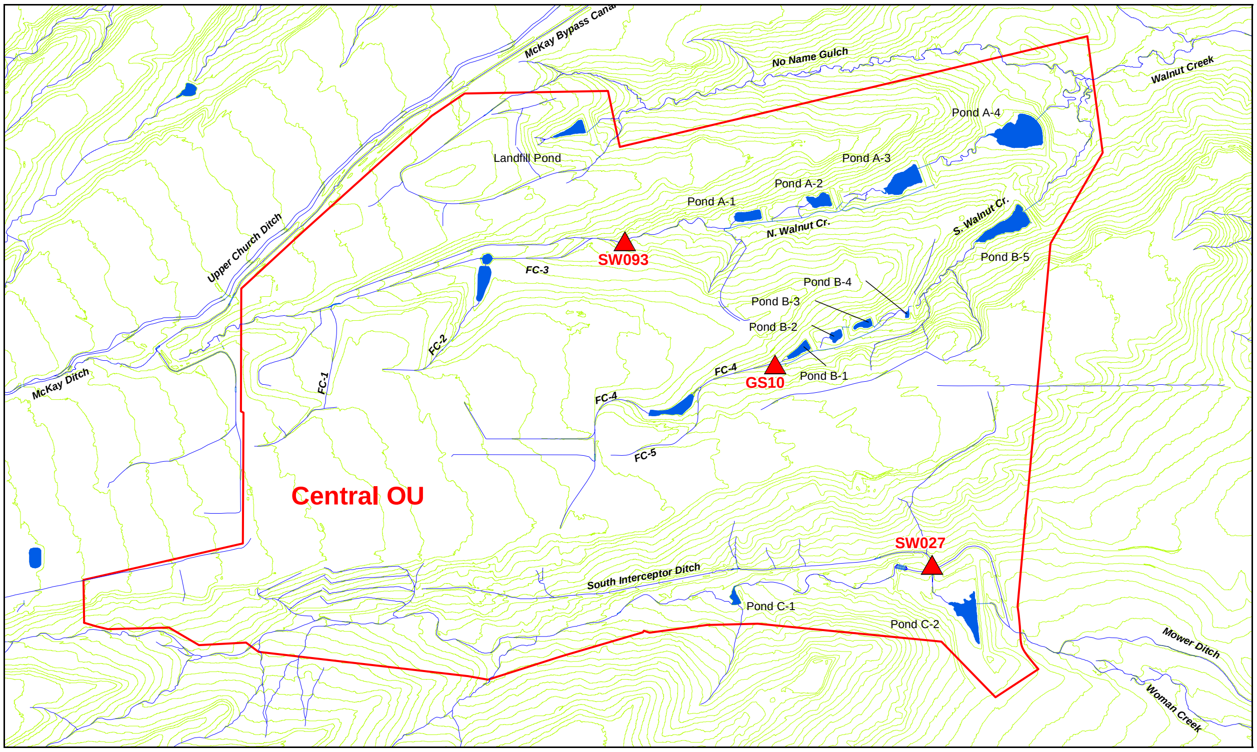


Figure 3–5. POE Monitoring Locations

The following sections include summary tables and plots showing the applicable 30-day and 12-month rolling averages for the POE analytes. The evaluations include all results that were not rejected through the verification and validation process. Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations, activities, and analytical errors are often greater than the precision presented. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the "real" and "duplicate" values. When a sample has multiple "real" analyses (Site-requested "reruns"), the value used in calculations is the arithmetic average of the multiple "real" analyses.[4]

Refer to Appendix B, which contains the water-quality data, for further information.

Location GS10

Monitoring location GS10 is located on South Walnut Creek just upstream of the B-Series Ponds (Figure 3–5). The central portion of the COU contributes flow to GS10 through Functional Channel 4 (FC-4) and FC-5.

[4] Significant differences in values for a data pair are an indication of potential problems with sample preparation or analysis. Under these circumstances, an applicable value to be used for comparison cannot be determined with sufficient confidence to make compliance decisions. As such, an evaluation of the DER or RPD, depending on the analyte, is required to assess the representativeness of the sample and its usability for compliance decisions (see Section 8.2.3 of the RFSOG for discussion).

Table 3–11 shows that many of the annual average Pu and Am activities at GS10 were greater than 0.15 pCi/L during active Site closure. However, a significant reduction in both Pu and Am activities has been observed following Site closure. With the completion of the FCs, implementation of enhanced erosion controls, revegetation, soil stabilization, and lack of substantial runoff, transport of Pu and Am has been virtually eliminated. Figure 3–6 shows no reportable Pu or Am values during the year.

Table 3–11. Annual Volume-Weighted Average Radionuclide Activities at GS10 for 1997−2008

Calendar Year	Volume-Weighted Average Activity (pCi/L)		
	Am-241	**Pu-239,240**	**Total U**
1997	0.266	0.260	2.78
1998	0.109	0.158	3.06
1999	0.274	0.139	2.49
2000	0.421	0.195	2.23
2001	0.075	0.080	2.91
2002	0.087	0.061	2.88
2003	0.117	0.113	2.68
2004	0.136	0.314	2.48
2005	0.185	0.238	8.27
2006	0.010	0.014	13.43
2007	0.010	0.020	11.52
2008	0.025	0.020	15.56
Total (1997−2008)	0.181	0.166	3.66

Figure 3–7 shows reportable 12-month rolling averages for total U during the year. Details regarding notification and source evaluation are contained in Section 2.2.1.1, “Notification and Source Evaluation for Reportable 12-Month Rolling Total U Values at RFCA Point of Evaluation GS10” of the *Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2006* (DOE 2006c). The Site continues to evaluate, in coordination with CDPHE, the measured U concentrations at GS10. Recent data are summarized below in a source evaluation update.

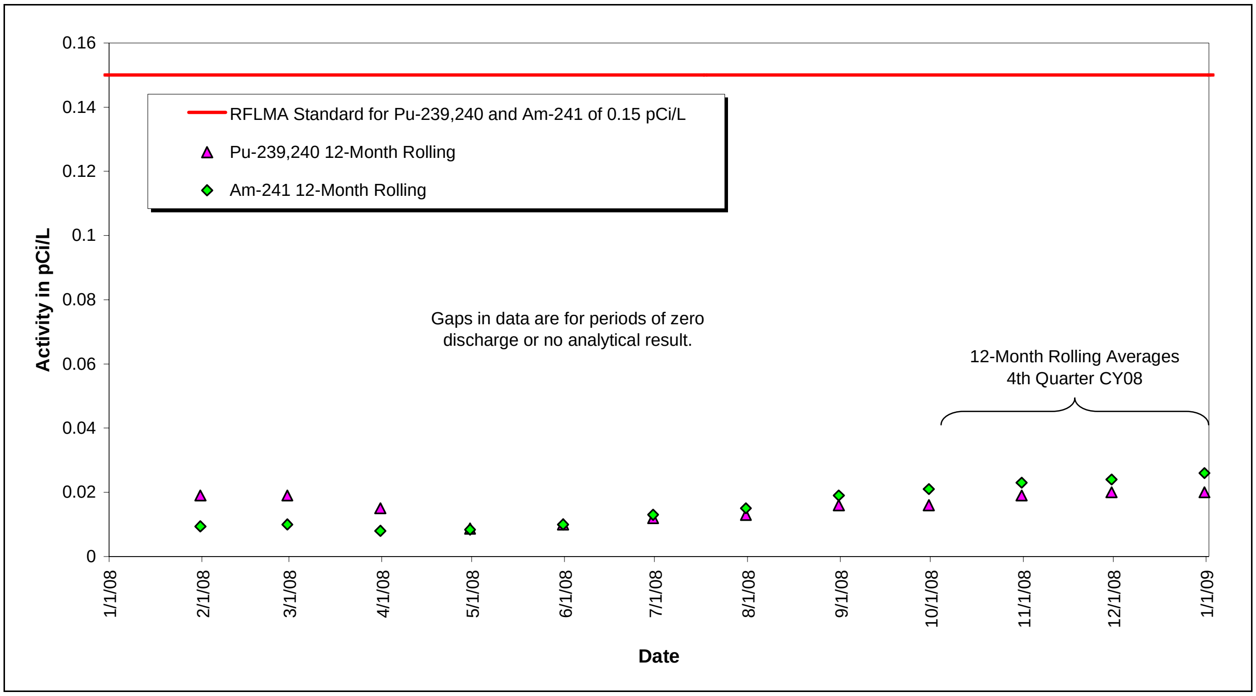


Figure 3–6. Volume-Weighted Average Pu and Am Compliance Values at GS10: Calendar Year Ending Fourth Quarter CY 2008

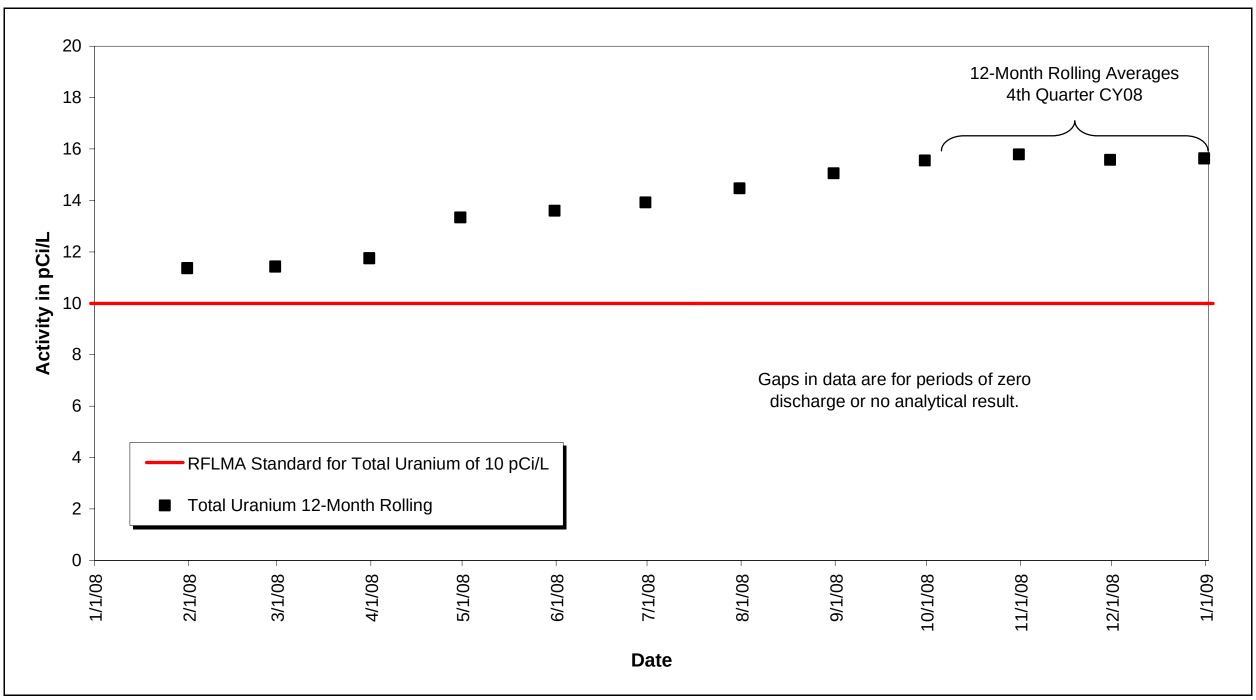


Figure 3–7. Volume-Weighted Average Total U Compliance Values at GS10: Calendar Year Ending Fourth Quarter CY 2008

Table 3–12 shows that all of the annual average metals concentrations were less than the standards/PQLs. Additionally, the long-term metals averages (1997−2008) were all less than the RFLMA standards/PQLs. Figure 3–8 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 3–12. Annual Volume-Weighted Average Hardness and Metals Concentrations at GS10 for 1997−2008

Calendar Year	Volume-Weighted Average Concentration (µg/L)				
	Hardness (mg/L)	**Total Be**	**Dissolved Cd**	**Total Cr**	**Dissolved Ag**
1997	138	0.50	0.09	4.05	0.11
1998	162	0.15	0.13	3.32	0.20
1999	139	0.16	0.07	4.08	0.15
2000	181	0.21	0.11	3.65	0.11
2001	222	0.32	0.11	5.95	0.11
2002	277	0.24	0.09	5.38	0.10
2003	228	0.22	0.10	6.91	0.12
2004	227	0.60	0.10	13.1	0.13
2005	401	0.88	0.06	17.5	0.15
2006	604	0.50	0.05	0.74	0.10
2007	383	0.50	0.10	0.89	0.10
2008	517	0.45	0.07	1.20	0.09
Total (1997−2008)	217	0.35	0.10	6.09	0.13

Ag = silver
Be = beryllium
Cd = cadmium
Cr = chromium

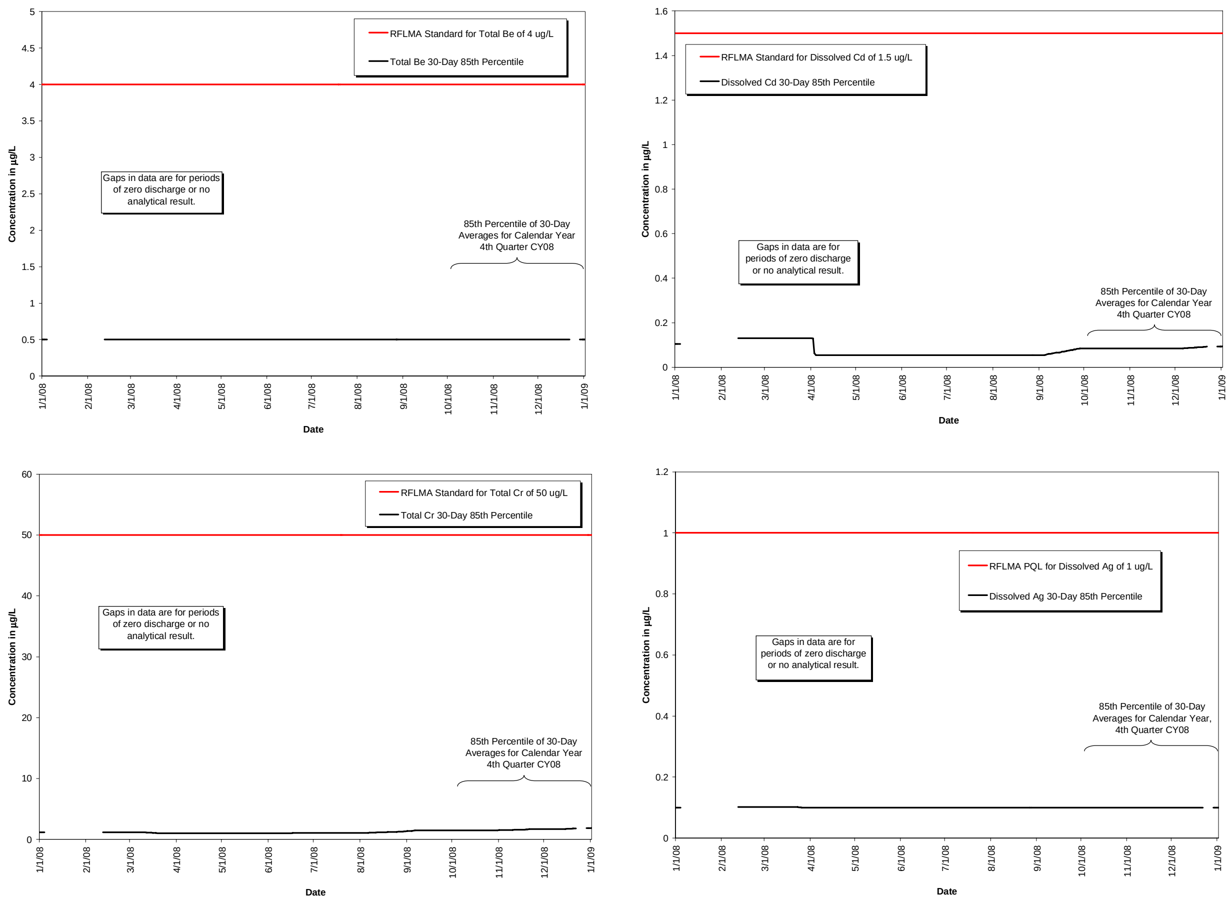


Figure 3–8. Volume-Weighted Average Metals Compliance Values at GS10: Calendar Year Ending Fourth Quarter CY 2008

Summary of Recent Reportable 12-Month Rolling Total U Values at POE GS10

This section provides follow-up information regarding the Site's July 13, 2006, notification of observed reportable concentrations of U in surface water at RFCA POE surface-water monitoring location GS10, which is located in South Walnut Creek upstream of Pond B-1 (Figure 3–1). Reportable U levels continue to be observed at GS10. The Site continues to evaluate, in coordination with CDPHE, the measured U concentrations at GS10. Note that this section includes the most recent data available; these data extend beyond the end of CY 2008.

DOE first became aware of the reportable 12-month rolling averages when all U sample results were validated on July 6, 2006. To meet the RFCA commitment at the time, DOE transmitted notification to EPA and CDPHE within the 15-day reporting period, which ended July 21, 2006. In addition, RFCA required that DOE, within 30 days of gaining knowledge of the reportable results, submit to EPA and CDPHE a source evaluation plan addressing reportable values. The July 13, 2006, notification letter served as both the comprehensive notice and the plan for that source evaluation, based on consideration for other evaluative work already performed in this drainage.

The characteristics of the current reportable period for U at GS10 are consistent with those for the previous reportable period during the summer of 2005. DOE provided notice for that reportable period on August 16, 2005 (05-DOE-00522).

The calculated 12-month rolling average for total U triggered the reporting requirements under RFCA Attachment 5, Section 2.4 (B), and subsequently Section 6.0 of RFLMA Attachment 2, beginning April 30, 2006, and not ended as of the end of CY 2008 (for details, see Table 3–13). All data used in the calculation of the 12-month rolling average through the end of CY 2008 have been validated. The end of the reportable period will be determined by subsequent data. Recent analytical results are listed in Table 3–14.

Table 3–13. Reportable 12-Month Rolling Average Values for POE Monitoring Location GS10

Analyte	Dates of Reportable Values	Range of 12-Month Rolling Average Values (pCi/L)
Total U	4/30/06−to be determined	10.19−15.79

Note: The standard for total U in Walnut Creek is 10 pCi/L.

Table 3–14. Recent Analytical Results for Composite Samples Collected at GS10

Composite Sample Start Date	Total U Analytical Result (pCi/L)
1/5/08	Insufficient quantity[a]
2/12/08	27.4
3/18/08	24.7
4/15/08	16.7
5/15/08	17.3
5/23/08	13.9
6/2/08	9.01
8/6/08	5.76
8/16/08	12.9
8/25/08	8.73
9/12/08	11.5
10/1/08	8.66
10/16/08	8.14
11/10/08	8.31
12/1/08	12.6
1/20/2009	15.4[b]

Note: [a] This sample was not analyzed due to faulty automated sampling caused by winter icing conditions..
[b] Unvalidated data

The following evaluation for South Walnut Creek monitoring station GS10 covers data received through March 30, 2009. Laboratory analyses for the composite samples collected for the periods February 23−March 12, 2009, and March 12−March 29, 2009, have not been completed. The composite sample started on March 29, 2009, is still in progress as of March 30, 2009. The following are included in this assessment:

- An evaluation of ongoing automated surface-water monitoring at GS10;
- An estimation of U loads at GS10; and
- An evaluation of water-quality trends and correlations at GS10.

Downstream Water-Quality Monitoring

Water flowing through GS10 also passes through the lower B-Series Ponds (Ponds B-4 and B-5) and South Walnut Creek before leaving the Site. POCs GS08 (Pond B-5 outlet) and GS03 (Walnut Creek at Indiana Street) again monitor this water during Pond B-5 discharges.

Pond B-5 was pre-discharge sampled on February 28, 2007. The total U concentration for that sample was 7.82 pCi/L. Pond B-5 was direct-discharged through the outlet to South Walnut Creek through POC GS08 starting on March 1, 2007, and ending on March 13, 2007. During the discharge period, six composite samples were collected at both POC GS08 and POC GS03. Total U concentrations in the GS08 samples ranged from 11.1 to 9.36 pCi/L. The 12-month rolling average at GS08 for March 31, 2007, was 9.99 pCi/L, just below the standard. Total U results at GS03 during the discharge ranged from 6.38 to 4.38 pCi/L; the highest 30-day average resulting from the discharge was 5.35 pCi/L.[5]

Pond B-5 was again pre-discharge sampled on May 4, 2007. Total U results for this sample (Site results) were significantly different than CDPHE results from the split sample. Based on the discrepancy, the decision was made to resample Pond B-5 for total U; samples were collected on June 7, 2007. The total U concentration for the June 7, 2007, sample was 7.8 µg/L (approximately 5.35 pCi/L). Based on that result, Pond B-5 was direct-discharged through the outlet to South Walnut Creek through POC GS08 starting on July 5, 2007, and ending on July 12, 2007. During the Pond B-5 discharge period, two composite samples were collected at POC GS08 and three composite samples were collected at POC GS03. Total U concentrations in the GS08 samples were 4.29 and 4.87 pCi/L. The 12-month rolling average at GS08 for July 31, 2007, was 8.39 pCi/L. Total U results at GS03 during the Pond B-5 discharge ranged from 3.47 to 3.99 pCi/L; the highest 30-day average at GS03 during the discharge was 2.17 pCi/L.[6] Pond B-5 has not been discharged since July 2007.

Pre-discharge samples were collected from Pond B-5 on September 16, 2008, in support of annual valve exercise activities. The total U concentration for this sample was 0.81 pCi/L. During the valve exercise, no water reached POC GS08.

GS10 Monitoring Results

As specified in RFLMA, the Site demonstrates compliance using 12-month rolling average values for select radionuclides at POE surface-water monitoring locations. Results for recent 12-month rolling average values using available data at GS10 are summarized in Table 3–13. Figure 3–9 shows the calculated compliance values and the individual sample results at GS10 for CY 2008 to date.

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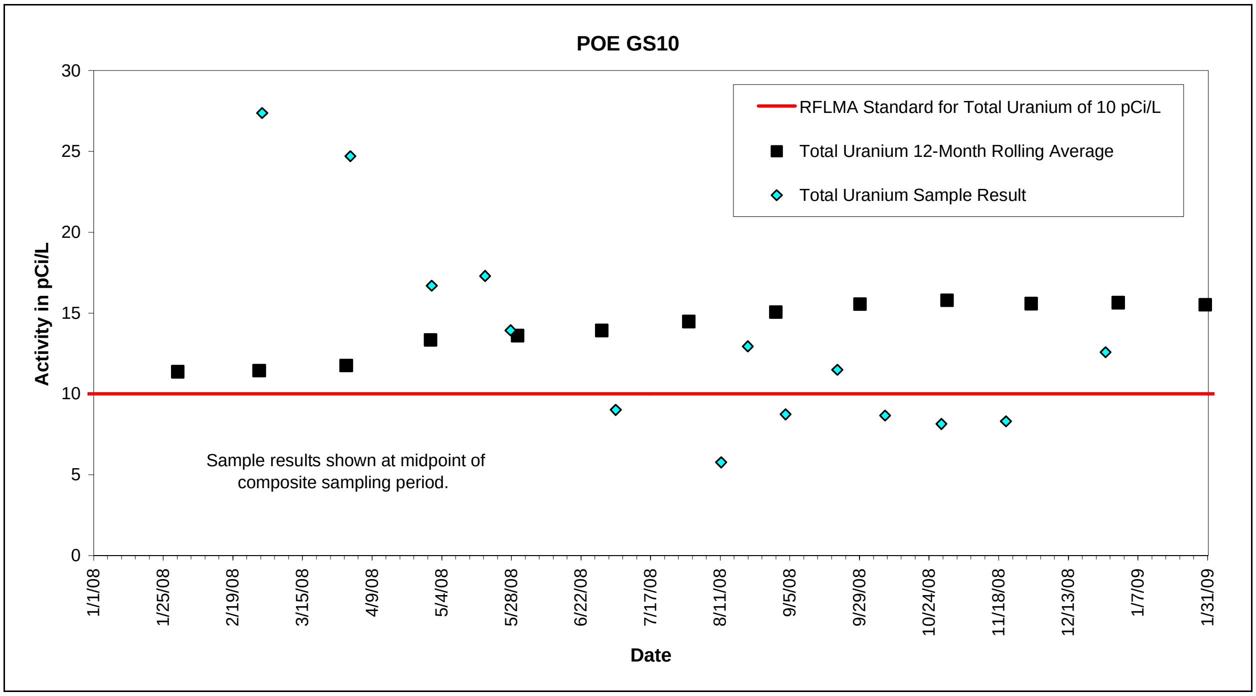
[5] Pond A-4 was concurrently discharged with Pond B-5 in March 2007; samples collected at GS03 included commingled water from both ponds.

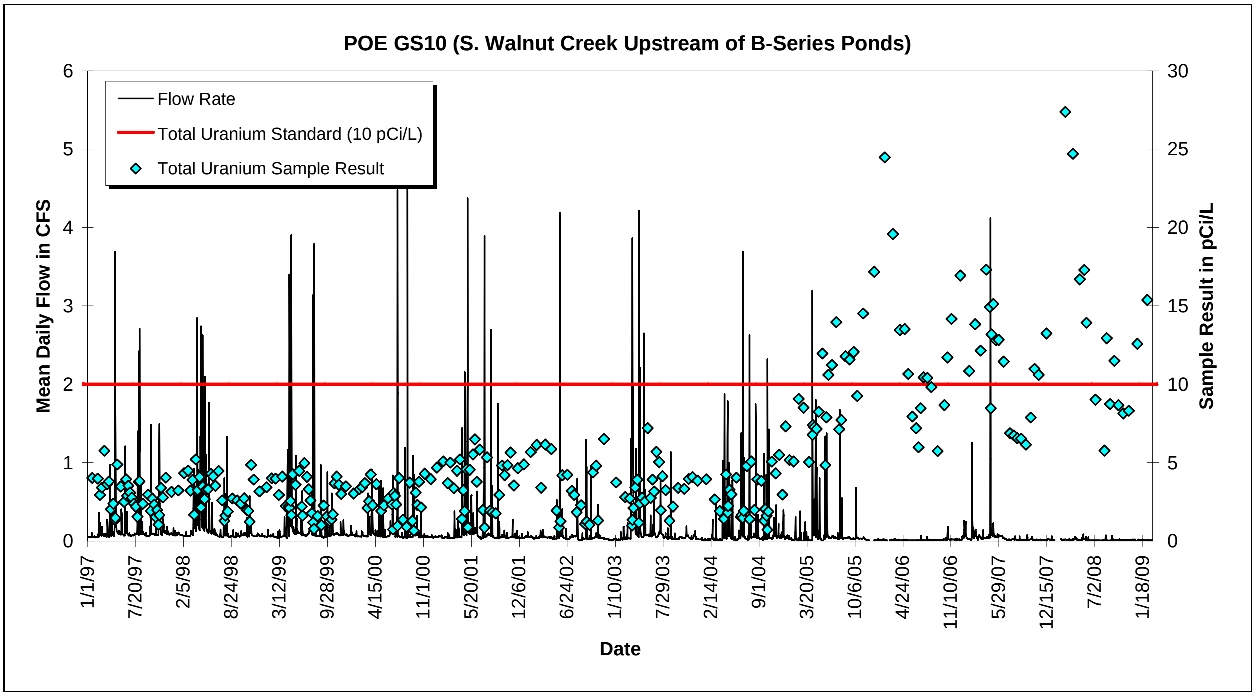
[6] Pond A-4 was also concurrently discharged with Pond B-5 in July 2007; samples collected at GS03 included commingled water from both ponds.



Note: Data through February 22, 2009. The latest result is unvalidated.

Figure 3–9. POE Monitoring Station GS10: Compliance Values and Individual Sample Results for Total U (January 1, 2008−February 1, 2009)

All analytical results for the composite samples collected during the period of reportable values have been validated through January 19, 2009. A review of historical GS10 monitoring data shows that these results are measurably higher than those for previous years (Figure 3–10). The significant reduction in runoff following Site closure can also be clearly seen on Figure 3–10.



Note: Data through February 22, 2009. Total U standard on this plot is shown for reference only; only 12-month rolling averages are compared to the standard. The latest sample result is unvalidated.

Figure 3–10. POE Monitoring Station GS10: Hydrograph and Individual Sample Results for Total U (January 1, 1997−February 22, 2009)

Data Summary and Analysis

Monitoring data were extracted from the former Soil Water Database or the current Site Environmental Evaluation for Projects (SEEPro) database. The following list describes the environmental data compilation process:

- Individual sample result values are calculated as arithmetic averages of real and field duplicate results when both results are from the same sampling event.[7]
- When available, Site-requested laboratory reruns are averaged with initial runs for the same sampling event.
- Laboratory duplicate and replicate quality control (QC) results are not used.
- When negative values for actinide measurement are returned from the laboratories due to blank correction, 0.0 pCi/L is used in the calculations.
- Only total radionuclide measurements are used.
- Data that did not pass validation (rejected data) are not used.

[7] Radionuclide data pairs are averaged when the DER is less than 1.5; sample pairs with DERs in excess of 1.5 are not used due to inferred lack of confidence in either result.

Verification and Validation of Surface-Water Analytical Results

Prior to Site closure, all surface-water isotopic data are either verified or validated, based on criteria determined by the Kaiser-Hill Company, LLC (K-H), by Analytical Services Division, or at the special request of the requestor. Approximately 75 percent of all isotopic data are verified, and the remaining 25 percent are validated. Validation is typically determined randomly for each subcontracted laboratory, based on the specific analytical suites. This random validation selection may or may not routinely include POE or POC locations. However, when reportable values are observed, all analytical results used in the calculations receive formal validation.

Under current LM procedures, all data are validated prior to being loaded into the SEEPro database.

High-Resolution Inductively Coupled Plasma/Mass Spectrometry (HR ICP/MS) and Thermal Ionization Mass Spectrometry (TIMS) Analyses

Prior to Site closure, groundwater and surface-water samples from select locations were sent to LANL for HR ICP/MS analysis, TIMS analysis, or both. These analytical methods measure mass ratios of four U isotopes (masses 234, 235, 236, and 238). Isotopic ratios provide a signature that indicates whether and the extent to which the source of U is natural or anthropogenic (manmade).

In August 2005, South Walnut Creek surface-water samples from SW056, SW141, and GS10, and groundwater samples from upgradient wells 91305, 99305, 91203, and 99405, were evaluated using HR ICP/MS and TIMS. The results indicate that, although concentrations of U vary widely, all the groundwater and surface-water locations produce water samples with a predominantly natural U isotopic signature. Location GS10, however, displayed a higher percentage of anthropogenic U than the other locations. Concentrations of U in groundwater samples collected in August 2005 from wells located upstream of GS10 vary from less than 5 μg/L at well 91203 (with a 93.4 percent natural U isotopic signature) to nearly 400 μg/L at well 99405 (with an isotopic signature that is 99.9 percent natural U). (A previous sample from the original well at this location, 99401, contained just over 650 μg/L U that was 100 percent natural.)

The results of all the HR ICP/MS and TIMS analyses are summarized in a report titled *Quantitative Evaluation of Mixture Components in RFETS Uranium Isotopic Analyses: Development & Verification/Validation of Calculations using an Excel Spreadsheet* by Dr. David R. Janecky, LANL (Janecky 2006; included as Attachment 3 to Section 8 of the Remedial Investigation/Feasibility Study (RI/FS) Report published in June 2006). This report provides a summary of the HR ICP/MS and TIMS results and calculations of U isotopic mixtures (mixtures between natural and anthropogenic [enriched and depleted] U). Dr. Janecky's analysis concludes that the U at GS10 is dominated by natural U, with a lesser amount of depleted and minimal-enriched U. An earlier sample analyzed by LANL, collected in May 2002, shows a generally similar isotopic signature, though the relative fraction of anthropogenic U is smaller.

Post-closure, the Site submitted to LANL additional samples, collected in 2007 and 2008, for high-resolution isotopic analyses. Results for GS10 LANL analysis are provided in Table 3–15. Table 3–16 lists the locations of the 2007 LANL samples. Results from the 2007 LANL analyses are summarized in the report titled *Thermal Ionization Mass Spectrometry Uranium Results for*

October 2007 RFETS Waters (Janecky et al. 2007). Table 3–17 lists the locations of the 2008 LANL samples. Results from the 2008 LANL analyses are summarized in the reports titled *Thermal Ionization Mass Spectrometry Uranium Results for September 2008 RFETS Waters* and *Thermal Ionization Mass Spectrometry Uranium Results for November 2008 RFETS Waters*, copies of which are included in Appendix E.

Table 3–15. U Concentrations and Isotopic Signatures from Samples Collected at GS10 as Reported by LANL

Date	U Concentration (µg/L)	% Depleted U	% Enriched U	% Natural U
5/1/02	9.4	22.1	0.04	77.8
8/11/05	13.2	36.2	0.10	63.7
7/23/07[a]	10.0	29.2	0.10	70.7
8/25/08	15.2	33.1	0.11	66.8

Source: Data are from RI/FS Section 8, Attachment 3, and the most recent LANL reports; data have been normalized to 100 percent.
[a]This sample included a duplicate analysis; data shown are arithmetic averages.

Table 3–16. CY 2007 Locations Selected for Sampling and High-Resolution U Analysis

Sample Location	Sample Date - Time	General Area
Well 80205	9/7/07 - 8:28	Downgradient OLF
Well 10594	9/11/07 - 14:29	North Walnut Creek downgradient of SPP
Well 99405	9/12/07 - 12:00	South Walnut Creek near former B991
GS03	7/9/07 - 16:50	Walnut Creek at Indiana Street
SPP Discharge Gallery	9/12/07 - 11:35	North Walnut Creek above Pond A-1
GS10	7/23/07 - 12:00	South Walnut Creek

Table 3–17. CY 2008 Locations Selected for Sampling and High-Resolution U Analysis

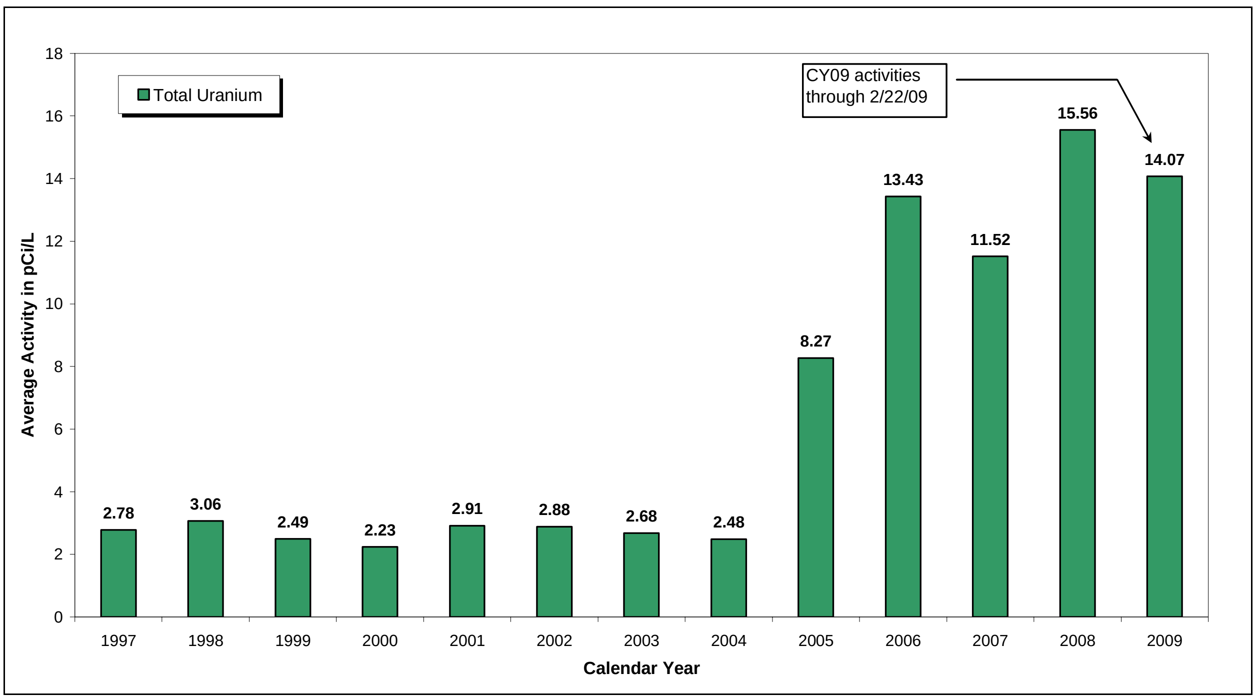
Sample Location	Sample Date - Time	General Area
SPIN	6/6/08 - 7:30	Influent to SPPTS
SPIN	8/20/08 - 10:30	Influent to SPPTS
Well 00193	8/25/08 - 13:18	Woman Cr. upstream of Pond C-2
Well B206989	9/2/08 - 11:02	Below Present Landfill Pond
Well 15699	8/27/08 - 10:45	Downgradient of MSPTS intercept trench
POM2	8/28/08 - 10:45 (incl. duplicate)	South Walnut Cr. at Pond B-4 outlet
GS13	5/15/08 - 9:24	North Walnut Cr. above Pond A-1
SW093	5/15/08 - 9:07	North Walnut Cr. at end of Functional Channel 3
SPP Discharge Gallery	5/14/08 - 23:25	SPPTS discharge gallery in N. Walnut Cr.
C2 POND	9/16/08 - 8:30	Pond C-2
PLFPONDEFF	9/16/08 - 9:00	Inlet to Present Landfill Pond outlet
A3 POND	9/16/08 - 9:15	Pond A-3
GS10	8/25/08 - 11:41	South Walnut Creek above Pond B-1
A4 POND	9/16/08 - 9:30	Pond A-4
B5 POND	9/16/08 - 9:45	Pond B-5

The samples from GS10 summarized in Table 3–15 illustrate the isotopic variability of the mixture of direct runoff and groundwater that contributes to surface-water flow at this location. Over longer periods, this variability may have a greater influence on the concentration and signature characteristics of the U in surface water.

Total U at GS10: Data Summary

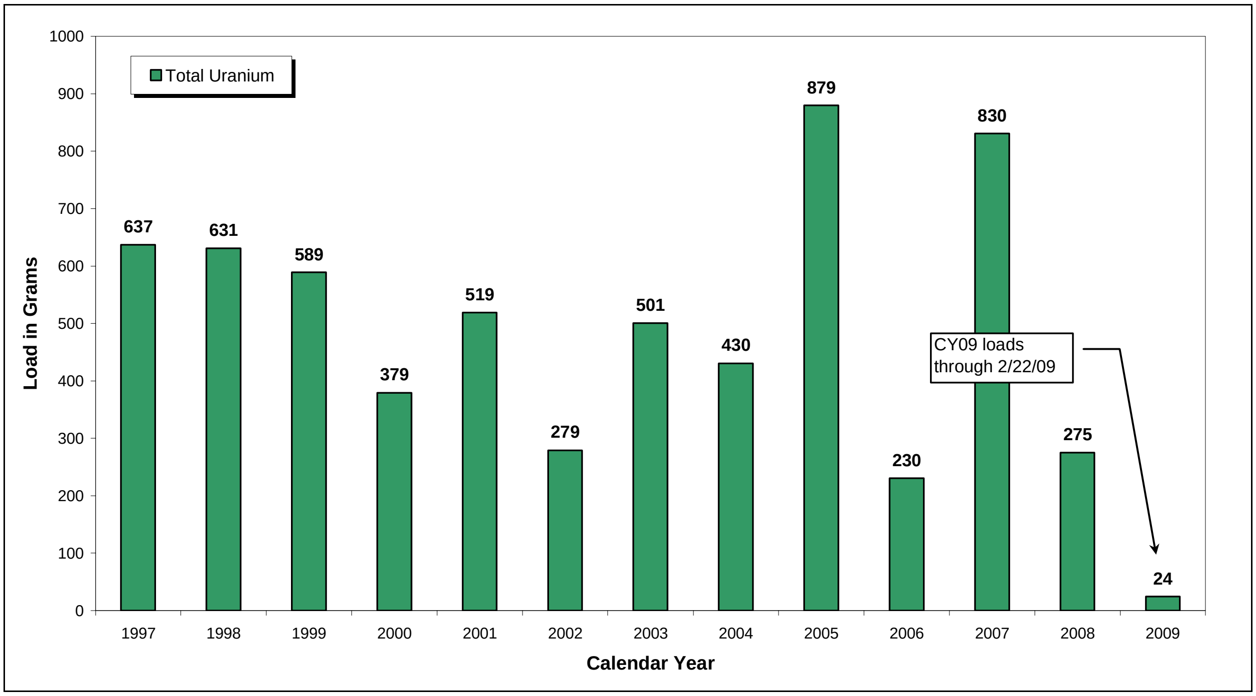
Figure 3–11 shows the volume-weighted average annual activity-concentrations (concentration in surface water expressed as activity per unit volume) for total U at GS10 during CY 1997−2008 and a portion of 2009. A measurable increase in concentration is noted starting in 2005.

Annual total U loads (mass) for GS10 in grams are plotted on Figure 3–12 to show long-term loading at GS10. The activity-concentration for each flow-paced composite sample is multiplied by the associated discharge volume to get picocuries (pCi), then converted to grams and totaled annually. Although reportable compliance values were observed during the 2005−2009 period shown, and concentrations in Figure 3–11 show a measurable increase, the loads for the 2005−2009 period shown are closer to historical ranges, and measurably lower in CY 2006 and 2008. This further suggests that the recently observed increased U concentrations at GS10 may be a result of changing hydrologic conditions, and not significant increases in the quantity of U reaching the creek.



Note: Data through February 22, 2009.

Figure 3–11. Average Annual Total U Concentrations at GS10: 1997−2009

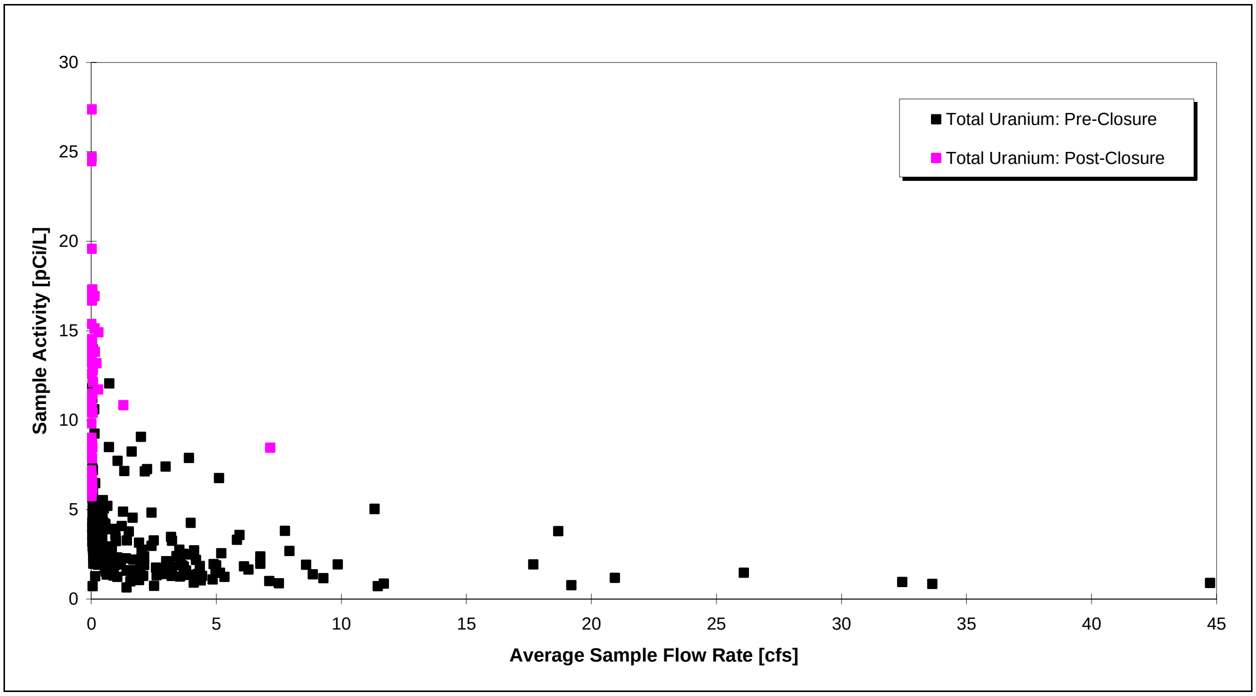


Note: Data through February 22, 2009.

Figure 3–12. Annual Total U Loads at GS10: 1997−2009

Figure 3–13 shows that the higher U concentrations are generally associated with lower flow rates, during periods of extended baseflow sustained by groundwater contributions.[8] As the area of impervious surfaces in the GS10 drainage was reduced by Site closure (i.e., removal of buildings, asphalt, and concrete), direct runoff to GS10 was also reduced. Similarly, removal of Site infrastructure likely resulted in reduced baseflow contributions from domestic and sanitary water leakage.[9] Therefore, groundwater contributions to the creek over the same period comprised an increasing portion of the flows monitored at GS10. Groundwater data from monitoring wells located near South Walnut Creek show naturally occurring U in concentrations that are considerably higher than the surface-water standard. Without the attenuation of U from groundwater sources by direct runoff and infrastructure leakage, increases in surface-water U concentrations would be expected.

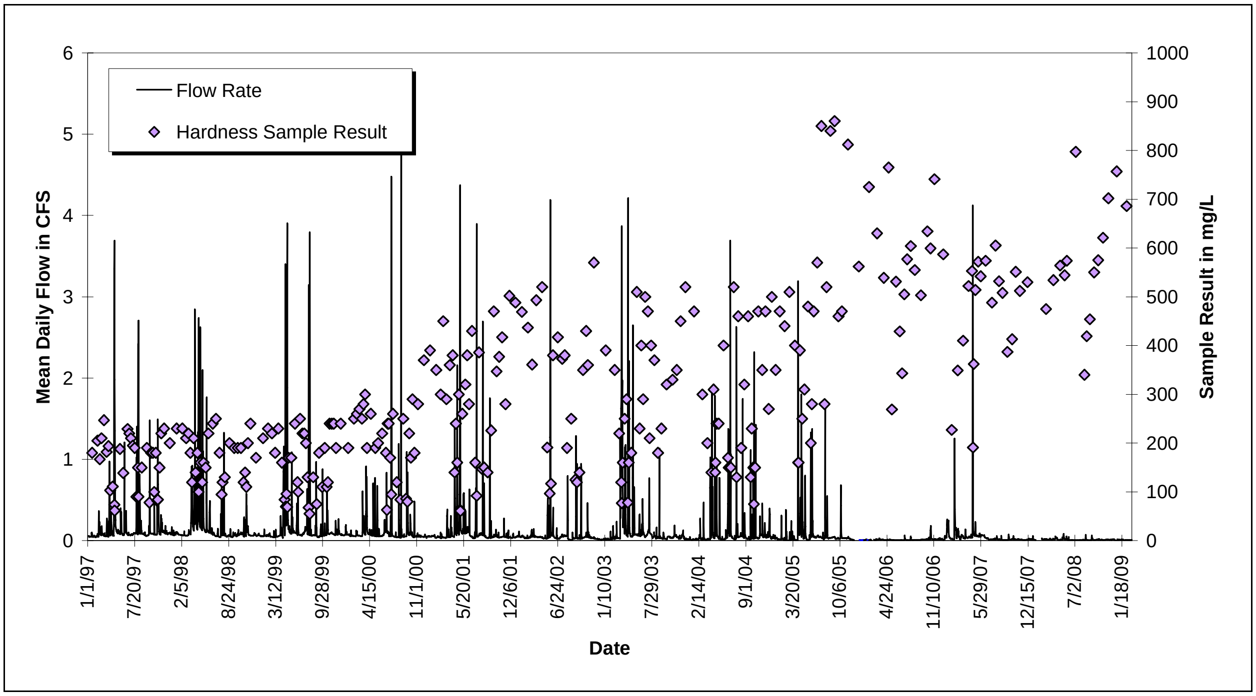
[8] These groundwater contributions occur as localized or distributed seeps to the streambed.
[9] Leaks from domestic and sanitary utility lines are presumed to have lower U concentrations than natural groundwater sources.



Note: Data through February 22, 2009.

Figure 3–13. Variation of Total U Concentration with Flow Rate at GS10: 1997−2008 and Portion of 2009

Hardness is measured for all composite samples at GS10 to support metals evaluation. Figure 3–14 shows individual sample results for hardness plotted with flow rate. A measurable increase in hardness is noted during the recent period of reduced flow rates and increased U concentrations (see Figure 3–10). In contrast, the measurably higher hardness concentrations starting in 2001 have been attributed to changes in the deicing products used at Rocky Flats starting with the winter of 2000−2001. Since groundwater generally shows higher hardness than surface-water runoff, these data further suggest an increase in the proportion of groundwater in flows at GS10.



Note: Data through February 22, 2009.

Figure 3–14. POE Monitoring Station GS10: Hydrograph and Individual Sample Results for Hardness (January 1, 1997−February 22, 2009)

Summary and Conclusions

Based on the above evaluation, Site personnel conclude that the recent U activities at GS10 are likely a result of changing hydrologic conditions (particularly the increasing groundwater component in surface-water flows at GS10, relative to conditions that prevailed prior to Site closure), and that no specific remedial action is indicated at this time. The data do not suggest a previously unknown localized source of contamination that warrants targeted remediation. The current conclusions are summarized below:

- Data collected from all terminal pond and fenceline POCs remain below reporting thresholds for all monitored analytes. However, increased U concentrations are being observed downstream of GS10.
- Past HR ICP/MS and TIMS analyses for both groundwater and surface-water samples collected upstream of GS10 all show a predominantly natural U signature (Janecky 2006; Janecky et al. 2007). While the five analyses[10] of surface water from GS10 indicate the existence of some anthropogenic U,[11] the normal variability of direct runoff and groundwater flow would be expected to strongly influence the U characteristics, both concentration and signature, over longer periods. To fully understand this variability, additional U data as they relate to the appropriate water-quality standard continue to be evaluated.

[10] Four LANL samples have been collected at GS10: May 1, 2002; August 11, 2005; July 23, 2007; and August 25, 2008. The July 23, 2007, sample includes a duplicate analysis.
[11] GS10 continues to show a predominantly natural uranium signature.

- Groundwater data within South Walnut Creek show naturally occurring U activities considerably higher than the surface-water standard. Baseflow at GS10 is sustained by groundwater expressions in the form of both localized seeps and distributed flow to the streambed.
- Surface-water data from GS10 generally show that the higher U concentrations are associated with lower flow rates, during periods of extended baseflow sustained by groundwater contributions. As the amount of impervious surface at the Site was reduced, direct runoff to GS10 was also reduced. Similarly, removal of Site infrastructure likely resulted in reduced baseflow contributions from domestic and sanitary water leakage. Therefore, groundwater contributions to South Walnut Creek now make up a larger portion of the flows monitored at GS10. Without the attenuation of U groundwater sources by direct runoff and infrastructure leakage, increases in surface-water U concentrations would be expected.

Location SW027

Monitoring location SW027 is located at the end of the SID at the inlet to Pond C-2 (Figure 3–5). The southern portion of the COU contributes flow to SW027 through the SID.

Table 3–18 shows that the majority of the annual average Pu and Am activities are less than 0.15 pCi/L. The significant increase in 2004 was the result of increased solids transport from disturbed areas associated with the 903 Pad/Lip accelerated actions. However, a significant reduction in both Pu and Am activities has been observed following completion of accelerated actions in the drainage. With the completion of the 903 Pad/Lip actions, implementation of enhanced erosion controls, revegetation, soil stabilization, and lack of substantial runoff, transport of Pu and Am approaching the action level has been virtually eliminated. The total U annual average activities are well below 11 pCi/L.

Table 3–18. Annual Volume-Weighted Average Radionuclide Activities at SW027 for 1997−2008

Calendar Year	**Volume-Weighted Average Activity (pCi/L)**		
	Am-241	**Pu-239,240**	**Total U**
1997	0.008	0.036	1.48
1998	0.021	0.156	3.45
1999	0.019	0.066	1.90
2000	0.060	0.348	1.10
2001	0.006	0.025	1.33
2002	0.001	0.003	0.53
2003	0.011	0.080	1.70
2004	0.413	2.273	1.05
2005	0.022	0.156	2.34
2006	NA (no flow)	NA (no flow)	NA (no flow)
2007	0.040	0.092	2.04
2008	NA (no flow)	NA (no flow)	NA (no flow)
Total (1997−2007)	0.058	0.318	1.84

Note: NA = not applicable.

SW027 did not flow during CY 2008. The last flow occurred on May 12, 2007. Therefore, no compliance values are calculated for CY 2008, and no compliance plots are presented.

Table 3–19 shows that all of the annual average metals concentrations are less than the standards. Additionally, the long-term metals averages (1997−2008) are less than the standards.

Table 3–19. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW027 for 1997−2008

Calendar Year	Volume-Weighted Average Concentration (µg/L)				
	Hardness (mg/L)	Total Be	Dissolved Cd	Total Cr	Dissolved Ag
1997	112	0.44	0.09	1.71	0.10
1998	152	0.14	0.15	0.91	0.21
1999	111	0.03	0.10	1.55	0.24
2000	150	0.27	0.05	4.14	0.09
2001	145	0.23	0.07	1.82	0.12
2002	114	0.12	0.05	2.88	0.11
2003	148	0.06	0.06	1.75	0.15
2004	133	0.32	0.06	7.36	0.19
2005	236	0.08	0.07	2.03	0.19
2006	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)
2007	133	0.50	0.05	0.50	0.10
2008	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)
Total (1997−2007)	138	0.21	0.08	2.28	0.16

NA = not applicable.
Ag = silver
Be = beryllium
Cd = cadmium
Cr = chromium

Location SW093

Monitoring location SW093 is located on North Walnut Creek 1,300 feet upstream of the A-Series Ponds (Figure 3–5). The northern portion of the COU contributes flow to SW093 through FC-2 and FC-3.

Table 3–20 shows that the majority of the annual average Pu and Am activities are below 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997−2008) are below 0.15 pCi/L. The average total U activities are all well below 10 pCi/L.

Table 3–20 indicates an increase in Pu and Am activities during 2004. However, a significant reduction in both Pu and Am activities has been observed following Site closure. With the completion of the FCs, implementation of enhanced erosion controls, revegetation, soil stabilization, and lack of substantial runoff, transport of Pu and Am has been virtually eliminated. Figure 3–15 and Figure 3–16 show no reportable Pu, Am, or total U values during the year.

Table 3–20. Annual Volume-Weighted Average Radionuclide Activities at SW093 for 1997−2008

Calendar Year	**Volume-Weighted Average Activity (pCi/L)**		
	Am-241	**Pu-239,240**	**Total U**
1997	0.035	0.052	2.38
1998	0.020	0.022	2.26
1999	0.025	0.038	1.95
2000	0.022	0.040	2.06
2001	0.011	0.015	2.14
2002	0.017	0.006	2.67
2003	0.039	0.056	2.34
2004	0.622	0.603	2.50
2005	0.029	0.022	3.97
2006	0.004	0.008	5.93
2007	0.009	0.011	3.78
2008	0.034	0.061	7.56
Total (1997−2008)	0.078	0.083	2.54

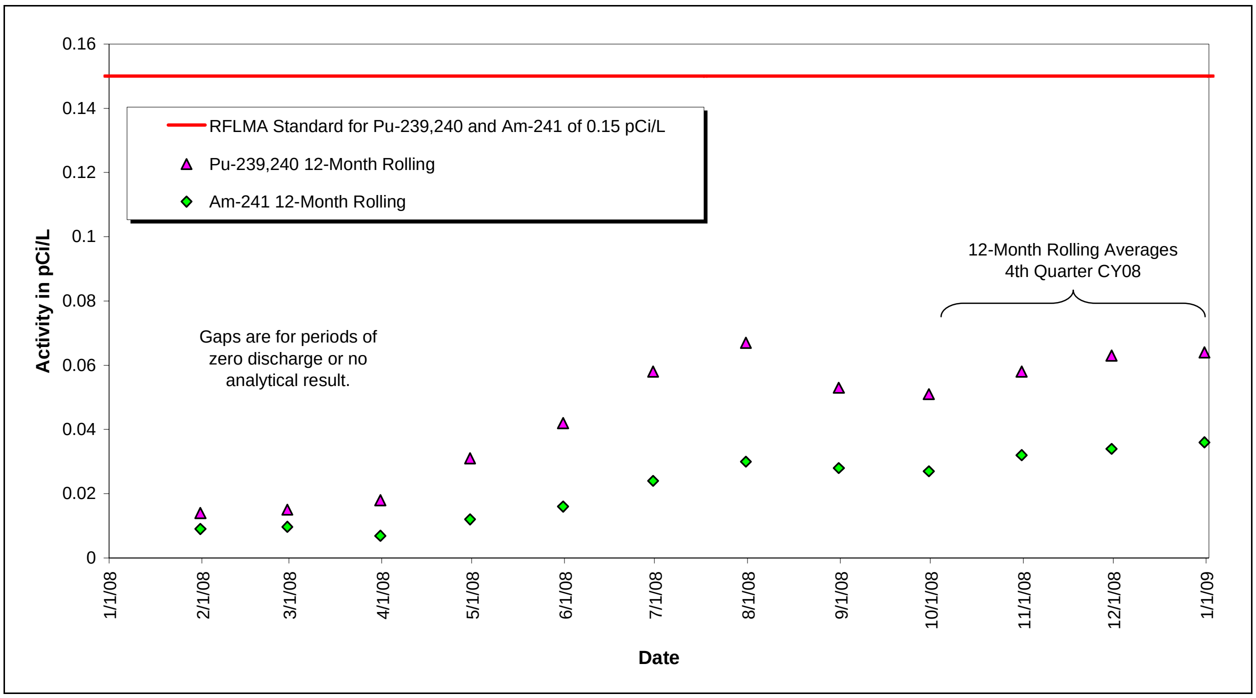


Figure 3–15. Volume-Weighted Average Pu and Am Compliance Values at SW093: Calendar Year Ending Fourth Quarter CY 2008

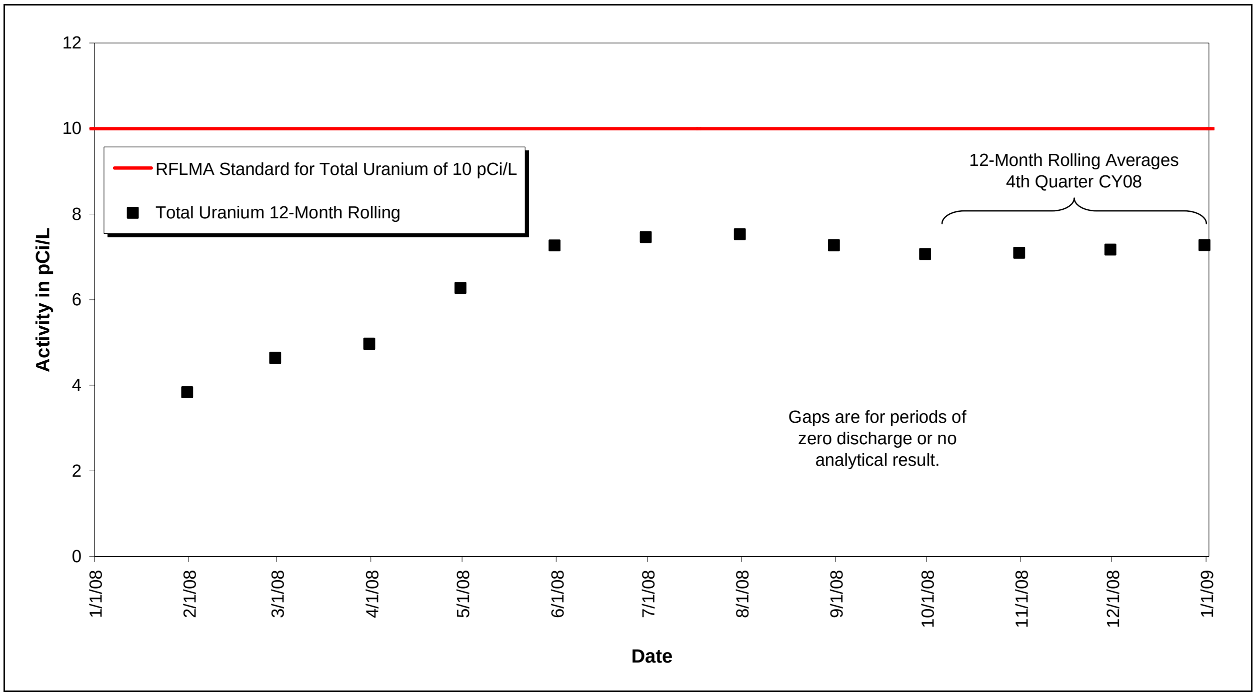


Figure 3–16. Volume-Weighted Average Total U Compliance Values at SW093: Calendar Year Ending Fourth Quarter CY 2008

Table 3–21 shows that all of the annual average metals concentrations are less than the standards. Additionally, the long-term metals averages (1997−2008) are less than the standards.
Figure 3–17 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 3–21. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW093 for 1997−2008

Calendar Year	Volume-Weighted Average Concentration (µg/L)				
	Hardness (mg/L)	Total Be	Dissolved Cd	Total Cr	Dissolved Ag
1997	168	0.43	0.07	2.36	0.12
1998	184	0.14	0.23	2.22	0.22
1999	152	0.20	0.13	5.08	0.16
2000	231	0.21	0.08	3.94	0.11
2001	247	0.36	0.07	6.49	0.11
2002	365	0.30	0.08	5.95	0.11
2003	257	0.29	0.09	6.88	0.16
2004	315	0.57	0.09	12.05	0.12
2005	337	0.11	0.05	1.92	0.11
2006	564	0.50	0.05	0.82	0.10
2007	287	0.50	0.06	0.82	0.10
2008	552	0.50	0.07	1.84	0.10
Total (1997−2008)	243	0.31	0.10	4.76	0.14

Ag = silver
Be = beryllium
Cd = cadmium
Cr = chromium

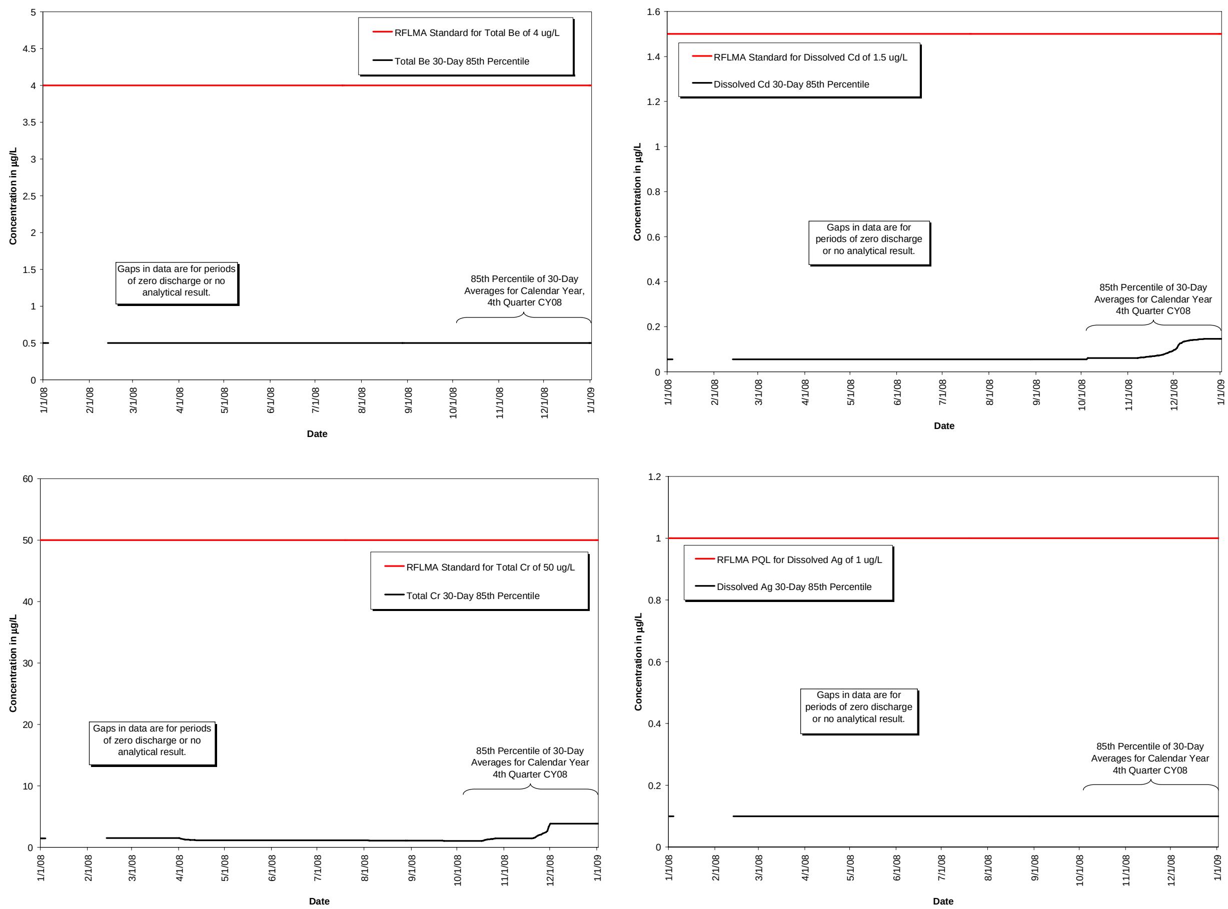


Figure 3–17. Volume-Weighted Average Metals Compliance Values at SW093: Calendar Year Ending Fourth Quarter CY 2008

3.1.2.3 AOC Wells and SW018

AOC wells (Figure 3–18 and Table 3–22) are located to evaluate potential groundwater impacts to surface water. Impacts are based on a minimum of two routinely scheduled sampling events in a row, not on a single data point. Analytical results from AOC wells are compared directly against the appropriate surface-water standards in Table 1 of RFLMA Attachment 2 or the RFLMA U groundwater threshold value of 120 µg/L. Analytical data from surface-water performance location SW018, where grab samples for volatile organic compounds (VOCs) are collected to support groundwater objectives, are assessed in a manner similar to data from AOC wells.

Table 3–22. Sampling and Data Evaluation Protocols at AOC Wells and SW018

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00193	Woman Creek upstream of Pond C-2	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 7 in Appendix D
00997	South Walnut Creek upstream of Pond B-5	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
10304	Southeast of 903 Pad/Ryan's Pit Plume at Woman Creek	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
10594	North Walnut Creek downstream of Pond A-1	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
11104	Downgradient, downstream	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 7 in Appendix D
4087	Below Landfill Pond	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
42505	Terminus of FC-2	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D
89104	Downgradient at Woman Creek	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D
B206989	Below Landfill Pond	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
SW018	FC-2 west of former Building 771 area	Semiannual grabs; Second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D

Notes: [a]Samples for the analysis of U are field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

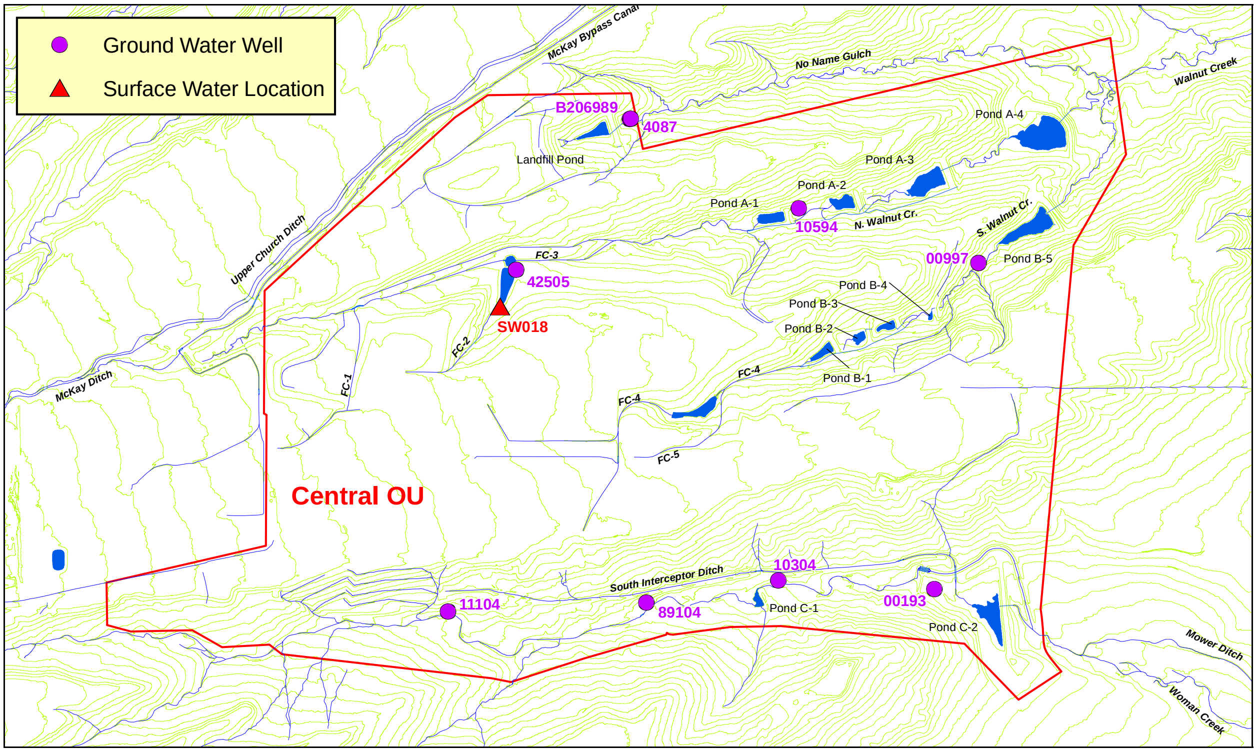


Figure 3–18. AOC Well and SW018 Locations

Data Evaluation

All AOC wells and SW018 were scheduled for routine monitoring in the fourth quarter of CY 2008. No decision criteria were triggered by the associated analytical results (Appendix B), which were consistent with previous data. Concentrations of U in samples collected from AOC well 10594 continue to suggest a reportable condition for this analyte will exist at some point in the near future. In the fourth quarter of CY 2008, the concentration was reported at 140 µg/L. As previously noted, concentrations of U in this well have repeatedly been determined to be 100 percent natural (most recently for a sample in September 2007 that was analyzed by LANL), and have exceeded the 120 µg/L threshold on numerous occasions in the past, both prior to and following Site closure. Monitoring will continue as prescribed in RFLMA (DOE 2007a).

A reportable condition was encountered for AOC well B206989 in August 2007 (see corresponding RFLMA Contact Record 2007-06) due to elevated concentrations of nitrate in groundwater samples from this well. Concentrations reported in the fourth quarter of CY 2008, 33 mg/L as nitrogen, are consistent with previous data. Updated S-K trend calculations for this well are provided in Appendix B and summarized in Section 3.1.5.3. These calculations continue to suggest that nitrate concentrations in samples from this well are decreasing, but at less than a 95 percent level of significance. However, this level of significance has reached 80 percent; refer to Section 3.1.5.4 for additional discussion.

3.1.2.4 Boundary Wells

Boundary wells (Figure 3–19 and Table 3–23) are located at the Walnut Creek/Indiana Street and Woman Creek/Indiana Street intersections to assure surrounding stakeholders that groundwater leaving the historic extent of the Rocky Flats Environmental Technology Site (RFETS) in these drainages is not adversely impacted by the Site.

Monitoring the Boundary wells is not required by the CAD/ROD. However, these wells are included in the network to satisfy operational monitoring requirements in RFLMA.

Table 3–23. Sampling and Data Evaluation Protocols at Boundary Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
10394	Woman Creek at Indiana Street	Annual grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
41691	Walnut Creek at Indiana Street	Annual grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D

Notes: [a]Samples for the analysis of U are field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

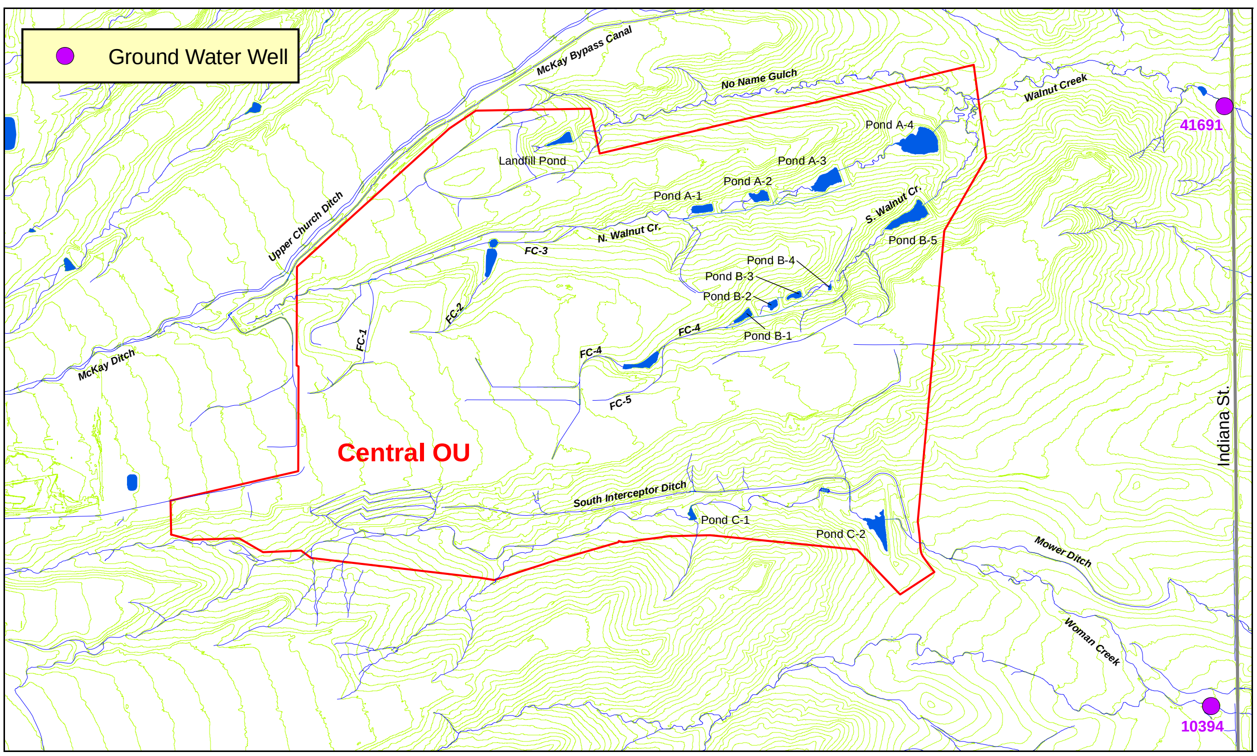


Figure 3–19. Boundary Well Locations

Data Evaluation

Both Boundary wells were sampled in the second quarter of CY 2008. All results were below RFLMA standards.

3.1.2.5 Sentinel Wells

Sentinel wells (Figure 3–20 and Table 3–24) are located near downgradient edges of contaminant plumes, in drainages, at groundwater treatment systems, and along contaminant pathways to surface water. These wells are monitored to determine whether concentrations of contaminants are increasing, thereby providing advance warning of potential groundwater-quality impacts to the downgradient AOC wells. Confirmation of a potential impact to downgradient wells will require an analytical record that consistently indicates an impact, not a single data point that indicates that a contaminant has been detected.

Sentinel wells are used to monitor the performance of an accelerated action (including soil and source removals, in situ contaminant plume treatment, groundwater intercept components of treatment systems, and facility demolitions) and assess contaminant trends at important locations. Data from Sentinel wells are supplemented by those from Evaluation wells, and are used to determine when monitoring may cease or additional remedial work should be considered.

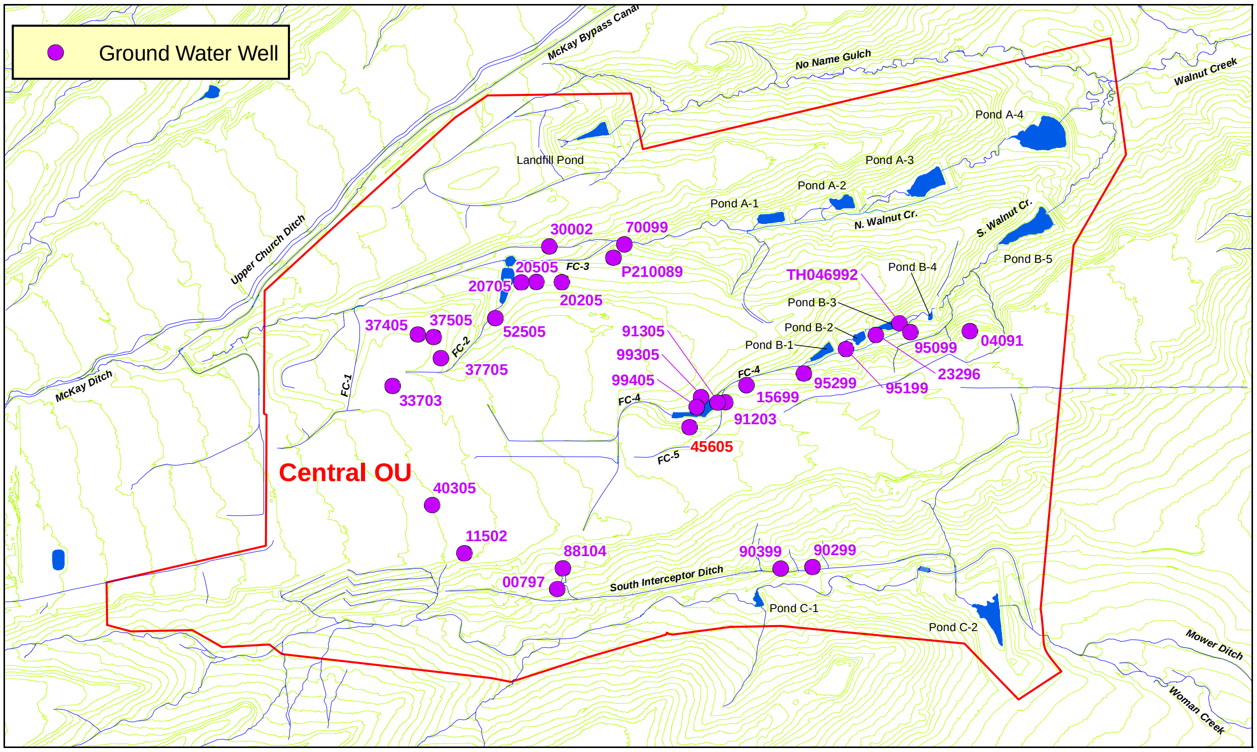
Table 3–24. Sampling and Data Evaluation Protocols at Sentinel Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00797	South of former Building 881 (B881) area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
04091	East of source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
11502	Southeast of former B444 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
15699	Downgradient of MSPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
20205	North/northeast of former B771/774 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, Pu, Am	See Figure 8 in Appendix D
20505	North of former B771/774 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, Pu, Am	See Figure 8 in Appendix D
20705	North/northwest of former B771 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
23296	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
30002	Downgradient at North Walnut Creek	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
33703	Downgradient of source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
37405	North/northeast part of former B371/374 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
37505	North part of former B371 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D

Table 3−24 (continued). Sampling and Data Evaluation Protocols at Sentinel Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
37705	East/southeast of former B371/374 area at foundation drain confluence	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
40305	East part of former B444 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
45605/ 45608[b]	Adjacent to remnants of SW056 French drain and drain interruption	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
52505	West of former IHSS 118.1 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
70099	Northwest (side-gradient) of SPPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 8 in Appendix D
88104	South part of former B881 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
90299	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
90399	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
91203	Downgradient of Oil Burn Pit (OBP) #2 source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
91305	South of confluence of FC-4 and FC-5	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
95099	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
95199	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
95299	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
99305	East part of former B991 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
99405	Southeast part of former B991 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
P210089	Downgradient (north) portion of SPP	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
TH046992[c]	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D

Notes: [a]Samples for the analysis of U are field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.
IHSS = Individual Hazardous Substance Site
[b]Well 45605 was abandoned to support the Slump Regrade Project; replacement well 45608 was installed in late March 2008. All samples collected from this location in CY 2008 utilized the replacement well, 45608.
[c]Well TH046992 was abandoned in October 2008 to support the Dam Breach Project. Because this well was redundant, it was not replaced. All RFLMA-required samples were collected from this location in CY 2008.



Note: Well 45608 replaces the slump-damaged 45605, which was abandoned in the fourth quarter of CY 2007; refer to the 2007 Annual Report (DOE 2008g) for more information.

Figure 3–20. Sentinel Well Locations

Data Evaluation

All Sentinel wells were monitored in the fourth quarter of CY 2008 (refer to Appendix B for analytical results).

Analytical data are generally consistent with previous results. As discussed in Section 3.1.3.5, well 45608 has replaced well 45605.

A result for trichloroethene (TCE) from well 23296 was called out in the 2007 Annual Report (DOE 2008g) because it was unusually low (8.5 µg/L). This condition was repeated by the fourth-quarter 2008 sample (7.9 µg/L), though the previous sample in the second quarter of 2008 was more typical of TCE concentrations at this location (240 µg/L). Conversely, the concentration of VC in the fourth-quarter 2008 sample was anomalously high (73 µg/L). While the B-2 and B-3 dams were undergoing breaching work in late 2008, a mechanism by which this would have been responsible for the fourth-quarter 2008 concentrations is not evident.

Vinyl chloride (VC) was detected at 0.64 µg/L ("J"-qualified, indicating this is an estimated concentration) in samples from well 52505, located between former Building 371/374 and Building 771. A similar result was reported in the fourth quarter of 2007. The presence of VC may indicate biodegradation of other, primary contaminants, such as tetrachloroethene (PCE) or TCE.

A number of other interesting data were reported in 2008 for Sentinel wells. These data and statistical results are discussed in greater detail in Section 3.1.5.3, and trend plots are included in Appendix B.

3.1.2.6 Evaluation Wells

Evaluation wells (Figure 3–21 and Table 3–25) are located within groundwater contaminant plumes and near plume source areas, and within the interior of the COU at the Site. As such, they may monitor the effects of accelerated actions that have been performed (e.g., source removal and in situ treatment). Data from these Evaluation wells are therefore appropriate to determine whether the monitoring of a particular plume and source area may cease, and provide data to support the determination of whether corresponding groundwater plume treatment systems may be decommissioned. In addition, Evaluation wells are used to support any groundwater evaluations that may be needed as a result of changing contaminant characteristics in downgradient Sentinel or AOC wells. Data from these wells also assist evaluations of predictions made through groundwater modeling efforts.

Table 3–25. Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00191	East of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
00203	Downgradient (south) portion of SPP	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
00491	Southeast of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
00897	Mound Site source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
3687	East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
03991	East of East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
05691	East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
07391	Ryan's Pit source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
18199	North of former IHSS 118.1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
20902	Northwest of former IHSS 118.1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
21505	West of former B776/777 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
22205	Downgradient (north) portion of SPP	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
22996	East/northeast part of former B886 area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
30900	PU&D Yard Plume source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33502	OBP#1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33604	OBP#1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33905	North of former 231 Tanks area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
40005	West part of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D

Table 3−25 (continued). Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
40205	South part of former B444 end	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
50299	East of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
51605	Downgradient, adjacent to GS13	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
55905	North part of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
56305	West part of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
70705	East part of former B707 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
79102	SPP source area - north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79202	SPP source area - north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79302	SPP source area - northeast	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
79402	SPP source area - northeast	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
79502	SPP source area - east	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79605	SPP source area - east	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
88205	South part of former B881 area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
891WEL	OU 1 Plume source area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
90402	Southeast of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
90804	Southeast part of 903 Pad/Ryan's Pit Plume	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
91105	OBP#2 source area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
B210489	Downgradient of SPPTS	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P210189	SEP-area VOC plume source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
P208989	SPP source area - north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
P114689	Southwest of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P115589	West part of former B551 Warehouse area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P419689	Southeast of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
P416889	Southeast of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D

Notes: [a]Samples for the analysis of U are field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.
IHSS = Individual Hazardous Substance Site
OBP = Oil Burn Pit
PU&D = Property Utilization and Disposal
SEP = Solar Evaporation Pond

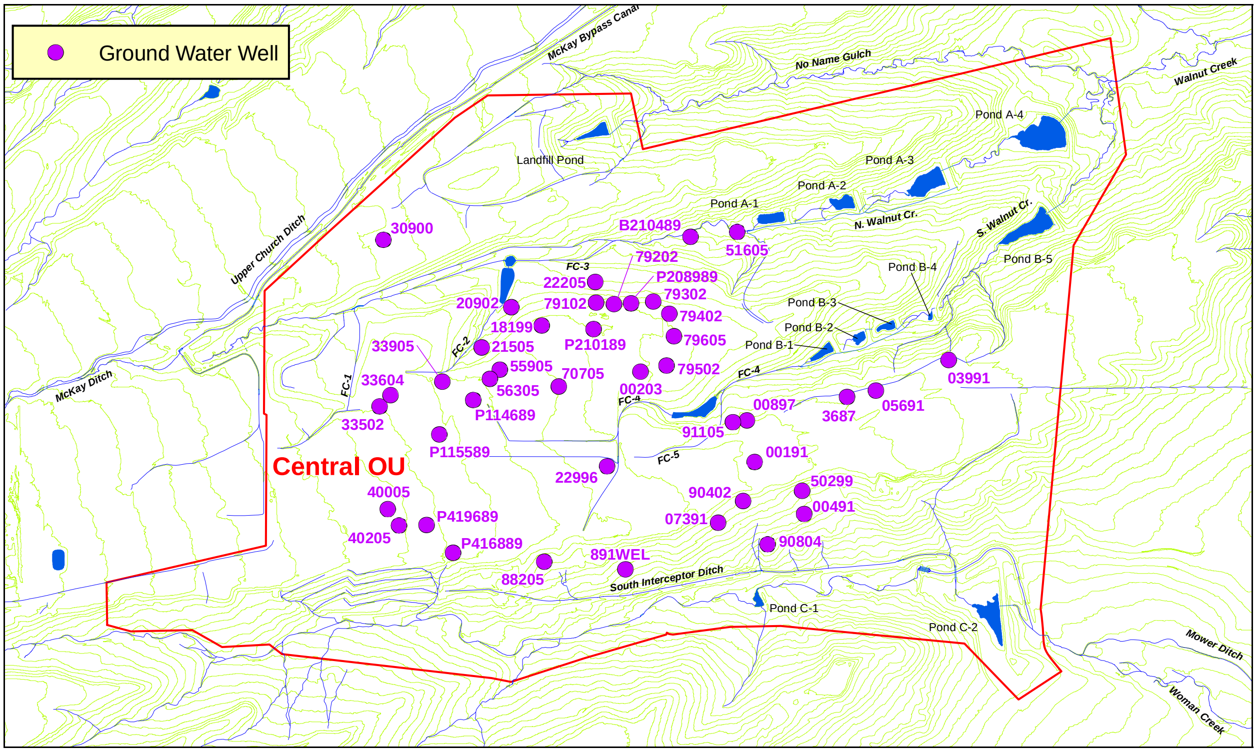


Figure 3–21. Evaluation Well Locations

Data Evaluation

All Evaluation wells were scheduled for routine monitoring in 2008. Several wells were dry and did not produce samples. Analytical results are discussed in the text that corresponds to the various contaminant plumes and areas of interest.

3.1.2.7 Investigative Monitoring

When reportable water-quality measurements are detected by surface-water monitoring at POEs or POCs, additional monitoring may be required to identify[12] the source and evaluate for mitigating action. Although not required by RFLMA, this investigative monitoring objective is intended to provide upstream water-quality information if reportable water-quality values are detected at POEs or POCs. Data collection is generally limited to POE and POC analytes and is intended to be discontinued once acceptable water quality has been demonstrated at POEs and POCs for an extended period.

Data collection is currently implemented at the locations listed in Table 3–26 and shown on Figure 3–22. The majority of these locations are sampled primarily to satisfy other monitoring objectives, though the data are used for this investigative objective. The current locations were not chosen in response to a specific source evaluation; they were chosen preemptively as a best management practice immediately following cleanup and closure work and are intended to be discontinued under this monitoring objective based on data evaluation. Any future data

[12] Note that the term “identify” is used here to mean “locate.” Characterization is also implied.

collection upstream of POEs and POCs, subject to the consultative process, is not limited to the locations in Table 3–26. The parties may also elect to collect data using other methods, subject to the characteristics of the reportable water-quality values and through the consultative process.

Table 3–26. Sampling and Data Evaluation Protocols at Investigative Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS05	Woman Creek at western POU boundary	Continuous flow-paced composites; frequency varies (target is 8 per year)[a]	total U isotopes[b]	See Figure 6-15 in Appendix D
GS13	North Walnut Creek just upstream of A-Series Bypass	Continuous flow-paced composites; frequency varies (target is 8 per year)[a]	total U isotopes[b]	See Figure 6−15 in Appendix D
GS51	Drainage area tributary to the SID and south of former 903 Pad/Lip	Continuous flow-paced composites; frequency varies (target is 8 per year)[a]	total Pu and Am; [TSS[c]]	See Figure 6−15 in Appendix D
GS59	Woman Creek 800 feet east of OLF	Continuous flow-paced composites; frequency varies (target is 8 per year)[a]	total U isotopes[b]	See Figure 6−15 in Appendix D
SW018	FC-2 west of former Building 771 area	Continuous flow-paced composites; frequency varies (target is 8 per year)[a]	total Pu and Am; [TSS[c]]	See Figure 6−15 in Appendix D

Notes: [a]Frequency depends on available flow.
[b]U isotopes are U-233,234 + U-235 + U-238.
[c]Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS hold-time limits.

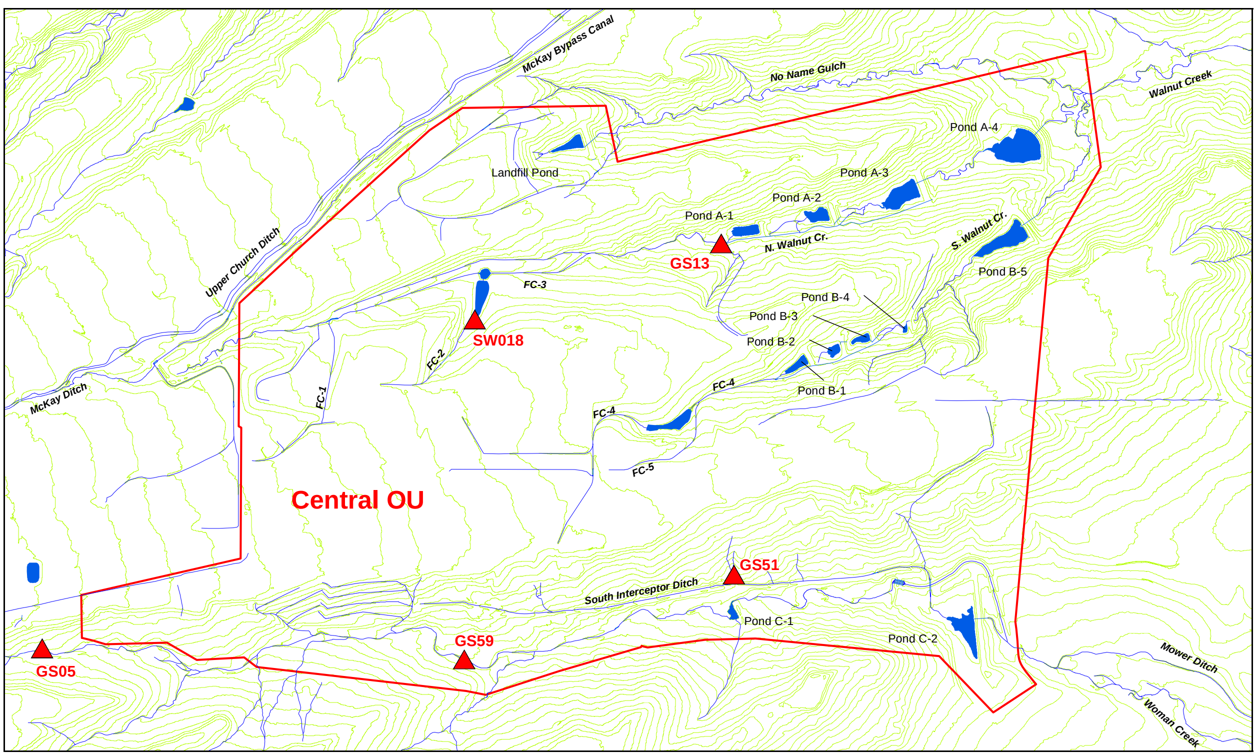


Figure 3–22. Investigative Monitoring Locations

Data Evaluation

During CY 2008, five investigative locations were operational (Table 3–26). As of November 26, 2007, analysis of composite samples collected at SW018 for Pu and Am has been discontinued. This action has been taken in accordance with the "Investigative Monitoring" flowchart (see Appendix D) for upstream locations where no reportable compliance values have been observed at a downstream POE or POC. Composite samples for Pu and Am will continue to be collected at SW018, but analysis will not be routinely conducted. These samples will be archived for 6 months and will only be analyzed if required by a source evaluation triggered by reportable compliance values observed at a downstream POE or POC.

No routine data evaluation for the investigative objective is presented in this report. Refer to Appendix B, which contains the water-quality data, for additional information.

3.1.2.8 PLF Monitoring

The PLF is located in the COU just north of the former Industrial Area (IA). This objective deals with monitoring surface water and groundwater at the PLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations (DOE 2004), and finalized in the PLF M&M Plan (DOE 2008a).

Water monitoring locations for the PLF are shown on Figure 3–23. The surface-water and treatment system monitoring requirements deal specifically with the PLFTS and are discussed in detail in Section 3.1.2.10. Details regarding general groundwater monitoring are provided below.

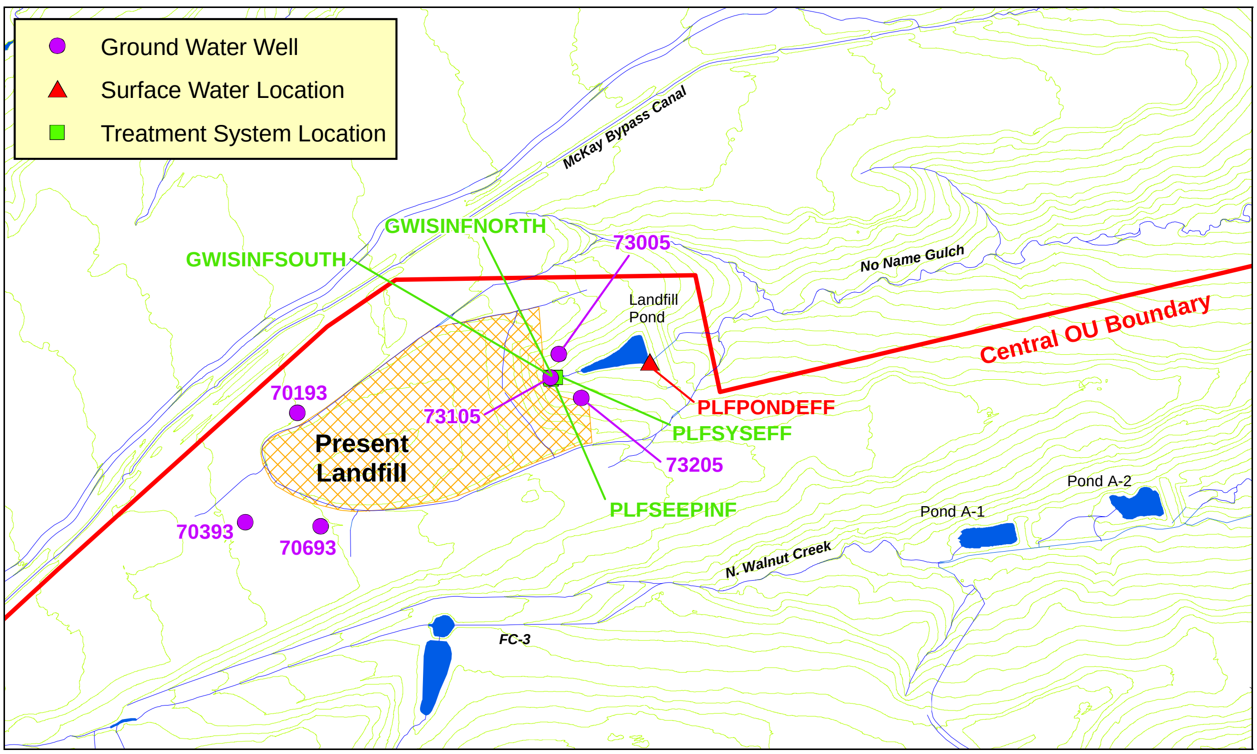
The RCRA monitoring network at the PLF comprises six wells: three are located upgradient of the landfill, and three, installed in 2005, are downgradient of the landfill but upgradient of the Landfill Pond. The RCRA wells are monitored in accordance with RFLMA. Decision rules are also set forth in that document; see Appendix D for the RFLMA decision flowcharts. Additional monitoring wells are present in the general vicinity of the PLF; however, they do not contribute to the RCRA monitoring of the landfill and are discussed in other sections of this report.

Sampling and data evaluation protocols for the RCRA wells at the PLF are provided in Table 3–27.

Table 3–27. Sampling and Data Evaluation Protocols at PLF RCRA Monitoring Wells

Location Code	Location Description	Sample Types/ Frequencies	Analytes[a]	Data Evaluation
70193	Upgradient (northwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
70393	Upgradient (west/southwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
70693	Upgradient (southwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73005	Downgradient (northeast) of the downgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73105	Downgradient (east) of the downgradient end of the PLF at the PLFTS	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73205	Downgradient (southeast) of the downgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D

Notes: [a]Samples for the analysis of metals are field-filtered using a 0.45-micron in-line filter.
Laboratory analytes are limited to those based on the analytical methods listed in the PLF M&M Plan.



Note: PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface-water location.

Figure 3–23. PLF Monitoring Locations

Data Evaluation

All RCRA wells at the PLF were sampled in the fourth quarter of CY 2008. Results are included in Appendix B.

This section presents the evaluation of the PLF groundwater-quality data for all of CY 2008. Monitoring performed in 2008 at the PLF RCRA wells is summarized in Table 3–28.

Table 3–28. RCRA Groundwater Sampling Performed in 2008 at the PLF

Well	Location	Q1	Q2	Q3	Q4
70193	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
70393	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
70693	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73005	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73105	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73205	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals

Notes: Q = quarter. Metals include U. Only RFLMA-defined (DOE 2007a) RCRA wells supporting the PLF are listed; other wells in the area (such as Sentinel and Evaluation wells) are omitted because they are not part of the RCRA monitoring network.

Downgradient water quality (as represented by analytical data from wells 73005, 73105, and 73205) was statistically compared against upgradient water quality (as represented by analytical data from wells 70193, 70393, and 70693). Generally speaking, water quality in the upgradient wells continues to be more impacted than that in the downgradient wells, because upgradient wells 70393 and 70693 are within the margins of the Property Utilization and Disposal (PU&D) Yard Plume.

Statistical evaluation of the analytical data from the PLF was performed using all nonrejected data for upgradient and downgradient RCRA wells. An interwell comparison was made (i.e., comparing upgradient wells against downgradient wells) in accordance with RFLMA and the PLF M&M Plan, using the Analysis of Variance (ANOVA) procedure as run using the Sanitas™ software package (Sanitas Technologies 2007). As discussed above, results for U were all converted to mass units: first, any negative values for isotopic analyses were replaced with 0.001, then the individual results were converted to mass units and summed to provide a conservative approximation of total U by mass. Replacement with 0.001 was also performed for any total U results that were equal to or less than zero to abide by software limitations, as discussed in Section 3.1.1.3. The data were also assessed for trends, again using Sanitas™ and the S-K trending method in keeping with the findings of previous studies indicating this method to be most appropriate for Rocky Flats groundwater data (K-H 2004a).

A year of quarterly analytical data (i.e., four sets of quarterly samples) are required to determine the baseline, and the same quantity of data are needed to perform the ANOVA statistical analyses. To calculate S-K trends based on four seasons—as represented by the four quarters of sampling—requires four sets of results for each of the four quarters. The downgradient wells were installed in late 2005 and were first sampled in the fourth quarter of that year. Therefore, while there is sufficient data for the ANOVA assessment, and while four fourth quarters of data have been reported, there are only 3 years of data for each of the first, second, and third quarters. There is not yet sufficient data for trend calculations.

The ANOVA evaluation of the groundwater analytical data from PLF RCRA wells indicates that groundwater sample results from some of the downgradient wells are statistically higher in the concentration of certain constituents. No VOCs were found in downgradient wells at statistically higher concentrations than in upgradient wells. However, the concentrations of several metals are statistically higher in downgradient wells. The statistical results are very similar to those reported in the 2007 Annual Report (DOE 2008g). All three downgradient wells produce groundwater samples with statistically higher concentrations of boron (B) and U than upgradient wells. The same applies to downgradient wells 73005 and 73205 for selenium (Se), and well 73105 for zinc (Zn). Table 3–29 summarizes the ANOVA results, the only differences from 2007 being the fact that samples from well 73005 are now also shown to be statistically higher in B concentrations than in upgradient wells, and samples from 73105 are statistically higher in Zn concentrations than in upgradient wells.

Table 3–29. Results of Groundwater ANOVA Evaluation for 2008 at the PLF

Analyte	73005	73105	73205
B	x	x	x
Se	x		x
U	x	x	x
Zn		x	

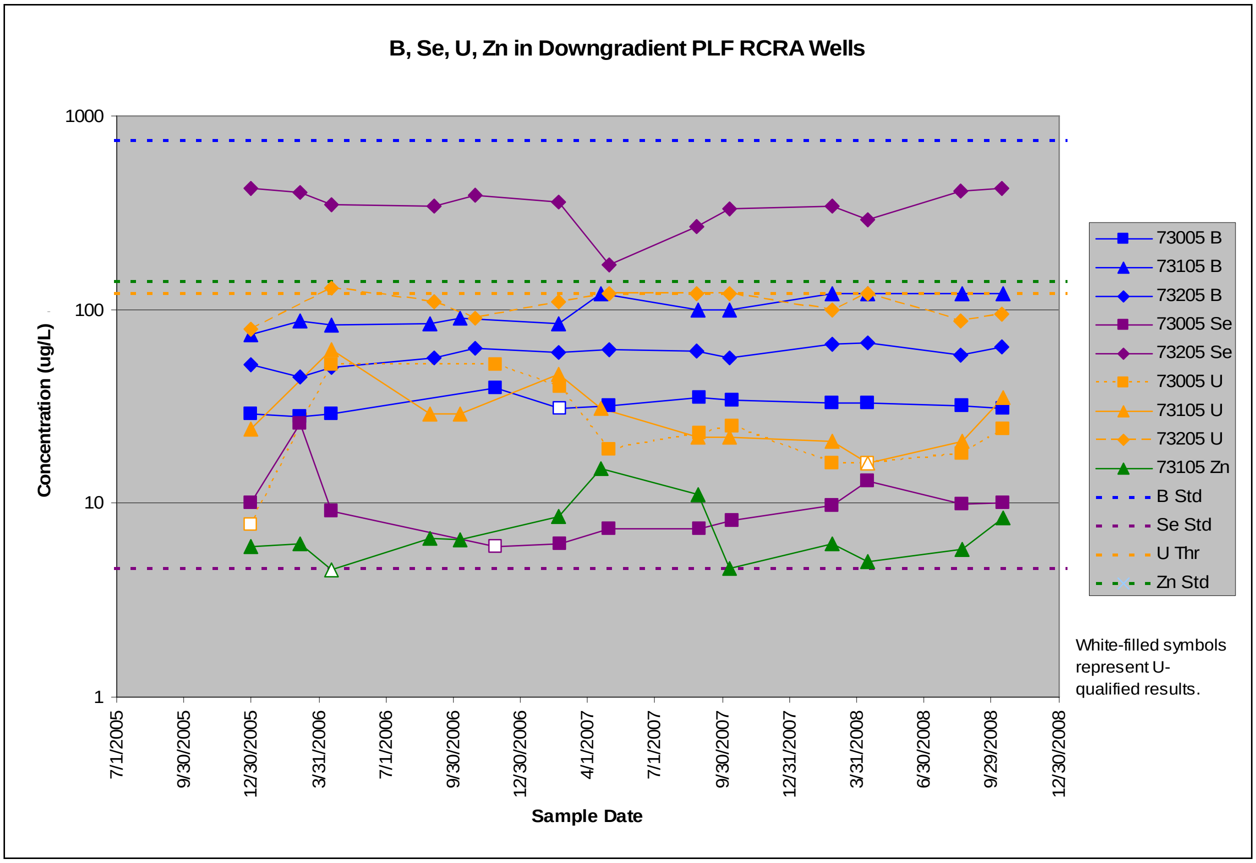
Note: x = analyte is present in groundwater at a statistically significant higher concentration in the indicated downgradient well compared to upgradient wells.

Concentrations of B in downgradient groundwater remain well under the RFLMA Table 1 standard of 750 µg/L. The same applies to concentrations of Zn (RFLMA standard = 141 µg/L) in samples from well 73105. Concentrations of Se in groundwater samples from downgradient well 73005 were consistently above the 4.6 µg/L RFLMA standard in 2008, though all four results are “J”-qualified and the highest concentration reported was 13 µg/L. As in 2007, concentrations of Se in samples from well 73205 are consistently well above the corresponding standard, ranging in 2008 from 290 µg/L to 420 µg/L.

Although all three downgradient wells produce samples with concentrations of U that are statistically higher than in upgradient wells, only well 73205 produces samples with concentrations that are close to the U threshold of 120 µg/L. To date, U data from this well include one result (collected in 2006) exceeding that concentration; in 2008, concentrations ranged from 88 µg/L to, on one occasion, 120 µg/L. The other downgradient wells produce groundwater samples with U concentrations that are lower than the threshold.

Time-series plots of reported B, Se, U, and Zn concentrations in groundwater samples from downgradient PLF RCRA wells are displayed on Figure 3–24.

Per RFLMA, if downgradient concentrations are significantly greater than upgradient concentrations *and* if downgradient concentrations show a statistically significant increasing trend, the consultative process is initiated to determine the appropriate response. As noted above, there are insufficient data for proper trend calculations, though the results of trending efforts are included in Appendix B. RCRA monitoring will continue in accordance with RFLMA, and future data will be assessed for statistical trend in these downgradient wells.



Notes: Only those analyte-well combinations identified in the ANOVA evaluation of PLF groundwater data as having statistically significant higher concentrations in downgradient RCRA wells (as listed in Table 3–29) are shown. RFLMA action levels are published in DOE 2007a. Note that the U data are compared to the U threshold. In addition to the nondetects ("U"-qualified results), numerous other results were qualified ("B," "J"), but are not shown differently for the sake of simplicity. Note logarithmic concentration scale.

Figure 3–24. B, Se, U, and Zn in Downgradient Groundwater from PLF RCRA Wells Identified in 2008 ANOVA Data Evaluations

Groundwater quality at the PLF is impacted on the upgradient side by VOCs from the PU&D Yard Plume. Data from the downgradient RCRA wells in 2008 included three detections of VOCs. All were for 1,3-dichlorobenzene (DCB), and all were "J"-qualified, indicating the reported concentrations were estimated. The highest concentration reported was 0.84 µg/L, well below the 94 µg/L RFLMA Table 1 value. These detections were reported at well 73105 in the third and fourth quarter of 2008, and well 73205 in the third quarter of 2008.

Groundwater flow at the PLF is strongly affected by the GWIS, which diverts groundwater flow around the perimeter of the PLF rather than through the wastes. The GWIS includes a slurry wall and perforated drain around the upgradient and side-gradient perimeter of the PLF, and acts to isolate groundwater within the PLF from that outside the PLF. (Refer to the previously published reports referenced earlier in this section for more detail on the GWIS and related discussions.) Previous RCRA and groundwater annual reports have confirmed the effectiveness of this isolation. Because the GWIS is located between the upgradient PLF RCRA wells and the downgradient PLF RCRA wells, estimating seepage velocities as discussed in Section 3.1.3.5 between those sets of wells is not appropriate.

3.1.2.9 OLF Monitoring

The OLF is located in the COU just south of the former IA. This objective addresses monitoring surface water and groundwater at the OLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Final Interim Measure/Interim Remedial Action for the Original Landfill (Including IHSS Group SW-2; IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond*, Appendix B, "Post-Accelerated Action Monitoring and Long-Term Surveillance and Maintenance Considerations" (DOE 2005a), and finalized in the OLF M&M Plan (DOE 2006b).

Four groundwater monitoring wells were identified to monitor the OLF and are classified as RCRA wells in RFLMA; three of these wells were installed in 2005. One of the OLF RCRA wells is located upgradient of the landfill, and three are downgradient of the landfill but upgradient of Woman Creek. The RCRA wells are monitored in accordance with RFLMA. Decision rules are also set forth in that document; see Appendix D for the RFLMA decision flowcharts. Additional monitoring wells are present in the general vicinity of the OLF; however, they do not contribute to the RCRA monitoring of the facility, and therefore, they are discussed in other sections of this report.

Surface-water and RCRA groundwater monitoring locations for the OLF are shown on Figure 3–25. Sampling and data evaluation protocols are summarized in Table 3–30 and Table 3–31.

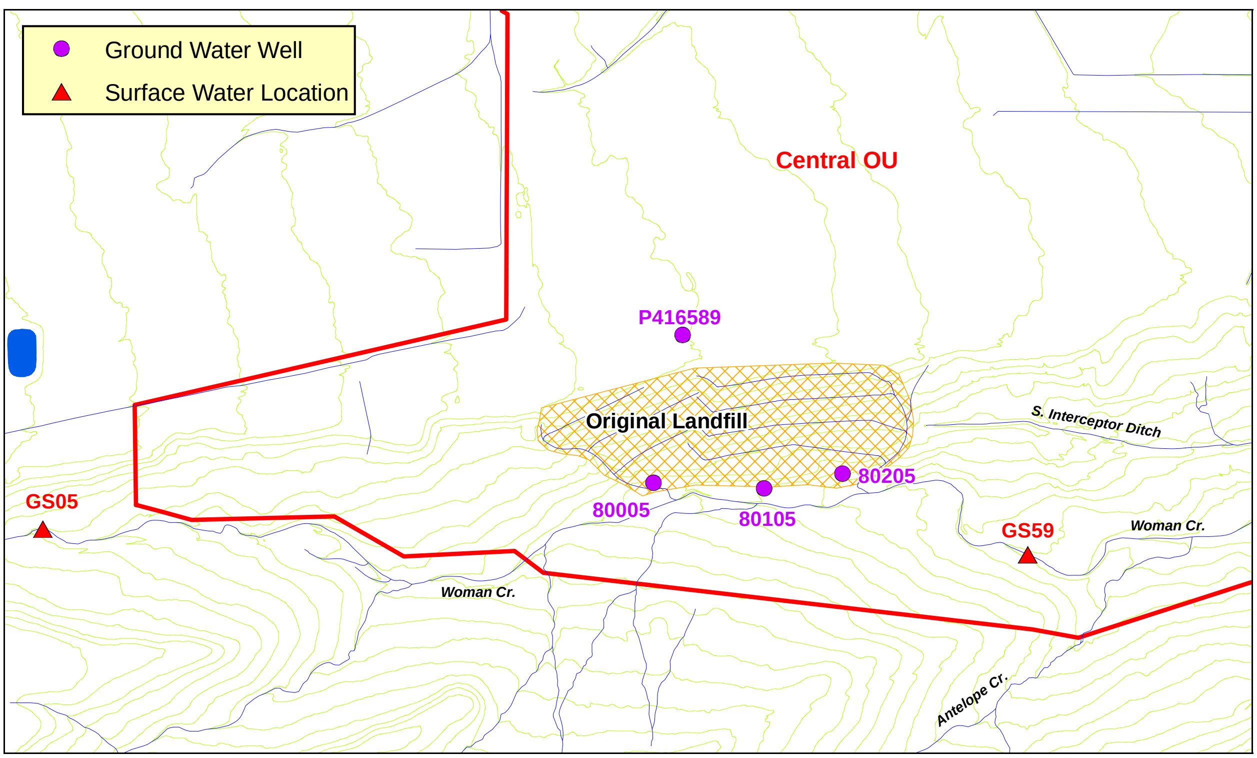


Figure 3–25. OLF Monitoring Locations

Table 3–30. Sampling and Data Evaluation Protocols at OLF Surface-Water Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes[b]	Data Evaluation
GS05; upgradient	Woman Creek at west POU fenceline	Quarterly grab samples[a]	Total U isotopes[c]; dissolved and total metals; VOCs; mercury	See Figure 12 in Appendix D
GS59; downgradient	Woman Creek 800 feet downstream of OLF	Quarterly grab samples[a]	Total U isotopes[c]; dissolved and total metals; VOCs; mercury	See Figure 12 in Appendix D

Notes: [a]Samples for isotopic U and metals are currently collected as continuous flow-paced composites in conjunction with the Investigative monitoring objective; decisions specifically for the OLF monitoring objective only require quarterly grabs.
[b]Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.
[c]U isotopes are U-233,234 + U-235 + U-238.

Table 3–31. Sampling and Data Evaluation Protocols at OLF RCRA Monitoring Wells

Location Code	Location Description	Sample Types/ Frequencies	Analytes[a]	Data Evaluation
P416589	Upgradient (north) of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80005	Downgradient (south) of the western portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80105	Downgradient (south) of the central portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80205	Downgradient (south) of the eastern portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D

Notes: [a]Samples for the analysis of metals are field-filtered using a 0.45-micron in-line filter.
Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.
SVOCs = semivolatile organic compounds

Data Evaluation

Analytical results for GS59 and GS05 are compared, per Figure 12 in Appendix D, to the appropriate surface-water standard in Table 1 of RFLMA Attachment 2. During CY 2008, Se was detected above the standard in three of the eleven composite samples collected (Table 3–32). Per the RFLMA data evaluation flowchart (Appendix D), sampling frequency for Se at the OLF surface-water locations was increased to monthly following the initial result above the standard. For the three samples above the standard, Se was not detected above the standard for three consecutive monthly samples, and sampling frequency subsequently decreased to quarterly. All other analytical results (including all other routine analytes) were acceptable during CY 2008.

Table 3–32. Se Analytical Results for Composite Samples Collected at GS59 in CY 2008

Composite Sample Start Date	Se Analytical Result (µg/L)	Se Analytical Result Qualifier
1/4/08	2.5	U
2/26/08	2.5	U
3/25/08	**5.4**	B
4/11/08	2.5	U
4/24/08	2.5	U
5/14/08	**7.0**	B
6/25/08	**8.2**	B
7/21/08	2.5	U
8/16/08	2.5	U
9/12/08	2.5	U
10/1/08	2.5	U

Note: Results highlighted in magenta are greater than the standard of 4.6 µg/L. Result qualifiers: U = analytical result below detection limit; B = analytical result (inorganics) is between the instrument detection limit and contract required detection limit.

All RCRA wells at the OLF were sampled in the fourth quarter of CY 2008. Results are included in Appendix B. This section presents the evaluation of the CY 2008 groundwater-quality data for the OLF, previously known as OU 5. All RCRA wells are monitored quarterly. Monitoring performed in 2008 is summarized in Table 3–33.

Table 3–33. RCRA Groundwater Sampling Performed in 2008 at the OLF

Well	Location	Q1	Q2	Q3	Q4
P416589	Upgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80005	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80105	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80205	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs

Notes: Q = quarter. SVOCs = semivolatile organic compounds. Metals include U. Only RCRA wells supporting the OLF are listed; other wells in the area (such as AOC, Sentinel, and Evaluation wells) are omitted because they are not part of the RCRA monitoring network.

In addition to monitoring and evaluating these wells similarly to RCRA wells (i.e., on a quarterly basis, and evaluating the resulting analytical data via upgradient-downgradient comparisons), the three downgradient wells are also monitored and evaluated in the manner of Sentinel wells. Specifically, data from these wells are statistically evaluated using 85th percentile concentrations to compare against surface-water standards, and data trends are constructed as warranted to determine a need for action. This type of evaluation requires a minimum of eight data points for each well-analyte combination to generate the 85th percentile concentrations, and four data points for each well-analyte-quarter combination to calculate trends.

As with the PLF, statistical evaluation of the analytical data from the OLF was performed using all nonrejected data for upgradient and downgradient RCRA wells. An interwell comparison was made (i.e., comparing the upgradient well against downgradient wells) in accordance with

RFLMA and the OLF M&M Plan (DOE 2006b), using the ANOVA procedure as performed with the Sanitas™ software package (Sanitas Technologies 2007). Results for U were all reported in mass units, so no conversions were necessary. An attempt was also made to assess the data for trends, again using Sanitas™ and the S-K trending method in keeping with the findings of previous studies indicating this method to be most appropriate for Rocky Flats groundwater data (K-H 2004a).

A year of quarterly analytical data (i.e., four sets of quarterly samples) are required to determine the baseline, and the same quantity of data are needed to perform the ANOVA statistical analyses. To date, the OLF is represented by more than 3 years (12 quarters) of data. To calculate S-K trends based on four seasons—as represented by the four quarters of sampling—requires four sets of results for each of the four quarters (i.e., for wells sampled quarterly, 4 years of data would be required). Therefore, while there is sufficient data for the ANOVA assessment, there is not yet sufficient data for trend calculations.

ANOVA evaluation of the groundwater analytical data from OLF RCRA wells indicates that groundwater samples from some of the downgradient wells are statistically higher in the concentration of certain constituents. No VOCs were found in downgradient wells at statistically higher concentrations than in upgradient wells, but the concentrations of two metals are statistically higher in one or more downgradient wells. These results are summarized in Table 3–34.

Table 3–34. Results of Groundwater ANOVA Evaluation at the OLF

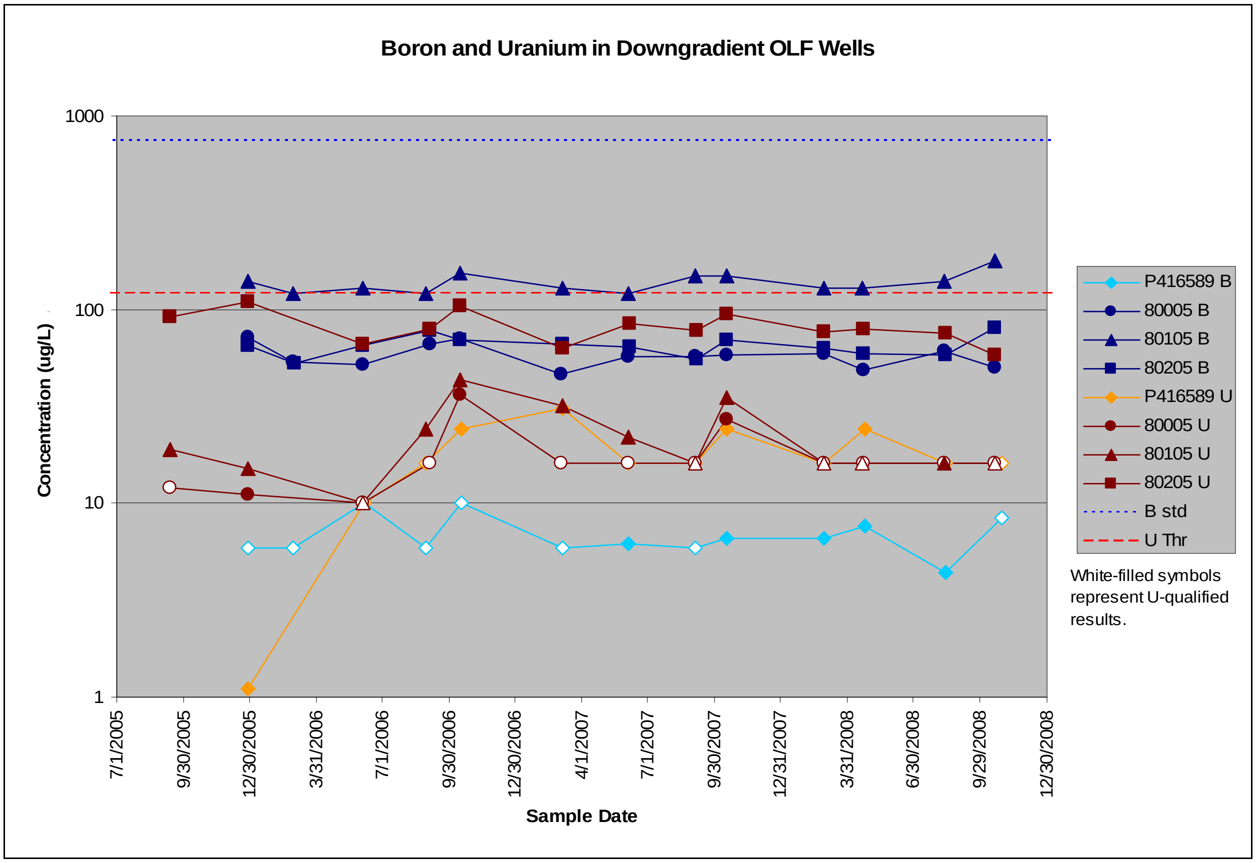
Analyte	80005	80105	80205
B	x	x	x
U			x

Note: x = analyte is present in groundwater at a statistically significant higher concentration in the indicated downgradient well compared to upgradient wells, based on ANOVA statistical analyses performed using the Sanitas™ software package.

All three downgradient wells produce groundwater samples with statistically higher concentrations of B than the upgradient well, and the same applies to concentrations of U in well 80205. This is identical to ANOVA results reported in the 2007 Annual Report (DOE 2008g).

Figure 3–26 provides time-series plots of reported B and U concentrations in groundwater from the wells listed in Table 3–34. Note that because these are the *reported* concentrations, data replacements for the purposes of statistical evaluations (i.e., replacing “U”-qualified data with 0.001) are not shown as the replacement value. As this figure indicates, concentrations of B in downgradient groundwater are uniformly well under the RFLMA Table 1 standard of 750 µg/L; the highest result reported to date is 180 µg/L (“J”-qualified) from well 80105. The surface-water quality reported at downstream OLF location GS59 does not indicate that B concentrations in downgradient OLF groundwater represent a threat.

Concentrations of U in samples from downgradient wells are also shown on Figure 3–26, as is the U threshold of 120 µg/L. U concentrations at downgradient wells have yet to exceed the U threshold, and it follows that the 85th percentile concentration of U in samples from well 80205 also does not exceed this threshold (as described in the Sentinel well decision rules that also apply to downgradient OLF RCRA wells). As with B, the surface water monitored at location GS59 has not indicated that U concentrations in downgradient OLF groundwater represent a threat to surface-water quality.



Notes: Only those analyte-well combinations identified in the ANOVA evaluation of OLF groundwater data as having statistically significant higher concentrations in downgradient RCRA wells are shown. RFLMA action levels are published in DOE 2007a. Note that the U data are compared to the U threshold. In addition to the nondetects ("U"-qualified results), several other results were qualified ("B," "J"), but are not shown differently for the sake of simplicity. Note logarithmic concentration scale.

Figure 3–26. B and U in Downgradient Groundwater from OLF RCRA Wells Identified in 2008 ANOVA Data Evaluations

Data reported in 2008 from downgradient RCRA wells at the OLF include five VOC detections, all qualified as estimates. Validated detections are summarized in Table 3–35.

Table 3–35. VOCs Detected in 2008 in Downgradient Wells at the OLF

Well	Sample Date	Analyte	Result	Units	Lab Qualifier
80005	2/28/08	1,3-Dichlorobenzene	0.23	µg/L	J
80105	4/22/08	1,2-Dichlorobenzene	0.15	µg/L	J
80105	4/22/08	1,4-Dichlorobenzene	0.17	µg/L	J
80105	8/12/08	Methylene Chloride	0.43	µg/L	J
80205	2/28/08	1,3-Dichlorobenzene	0.25	µg/L	J

Note: J = analyte detected, result is estimated. No validation qualifiers were attached to these results.

Groundwater flow at the OLF is not affected by controls such as the GWIS at the PLF. Groundwater flows beneath the pediment surface present north of the OLF in a general west to east direction. As it nears the southern edge of the pediment, groundwater is diverted to a more south-southeasterly direction. This latter general flow direction applies to groundwater moving through the OLF.

Groundwater flow velocities were calculated (see Section 3.1.3.5) for OLF well pair P416589 (the upgradient well) and 80105 (the middle downgradient well). The resulting estimates for the travel time from the upgradient to downgradient well range from just over 4 years to just over 4.5 years. Note that this calculated velocity is simplistic and applies only to pure water; contaminants would be retarded to varying degrees.

Seeps are also present at the OLF and have been observed in this area for decades (as well as being suggested on aerial photographs taken before the Rocky Flats Plant came into existence in the 1950s). Additional discussion of seeps at the OLF is provided in Section 2.4.2.3.

3.1.2.10 Groundwater Treatment System Monitoring

Contaminated groundwater is intercepted and treated in four areas of the Site. Three of these systems (MSPTS, ETPTS, and SPPTS) include a groundwater intercept trench (collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. Groundwater entering the trench is routed through a drain pipe into one or more treatment cells, where it is treated and then discharged to surface water. The fourth system (PLFTS) treats water from the north and south components of the GWIS and flow from the PLF seep.

Water monitoring at the MSPTS, ETPTS, and SPPTS includes a minimum of three sample-collection points: untreated influent entering the treatment system, treated effluent exiting the system, and a surface-water performance location. At the PLFTS, the treated effluent and surface-water sampling locations are typically the same; this is discussed in further detail below.

The fundamental questions at each system are whether (1) influent-water quality indicates that treatment is still necessary, (2) effluent-water quality indicates that system maintenance is required, and (3) surface-water quality suggests impacts from inadequate treatment of influent.

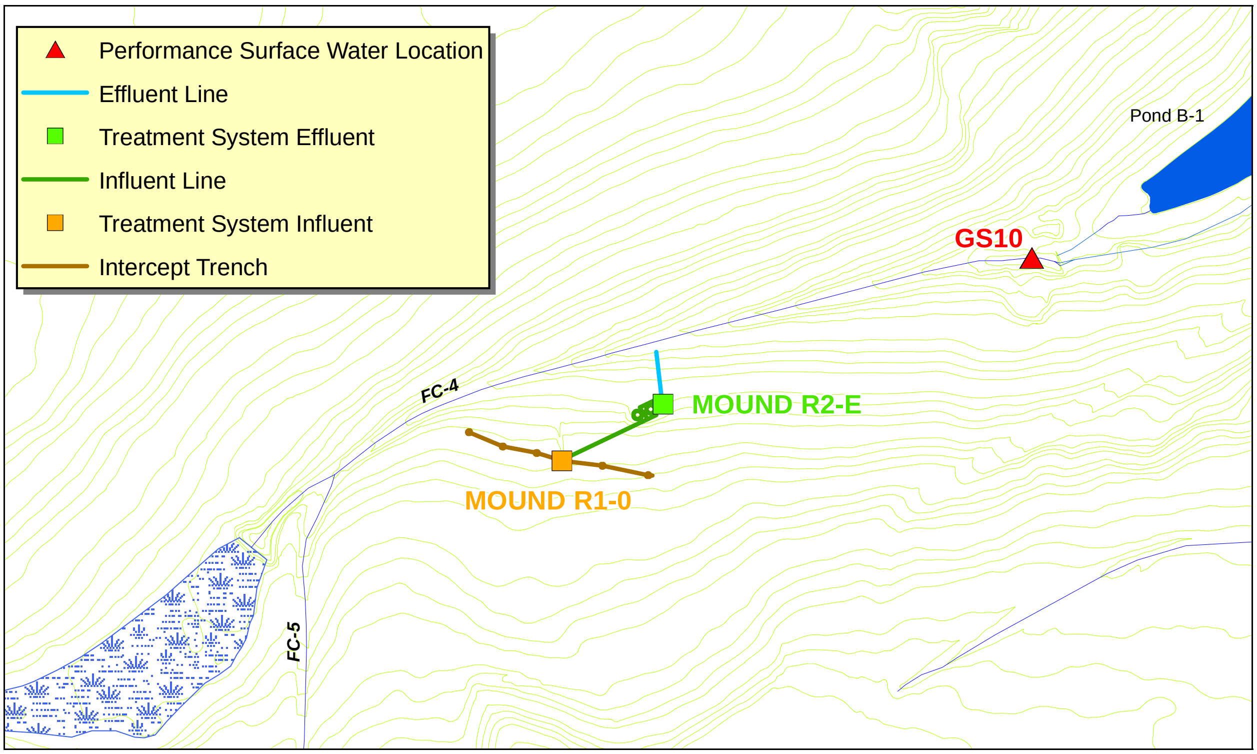
Note that groundwater monitoring wells also support the MSPTS, ETPTS, and SPPTS. These locations are not discussed in this section; rather, they are discussed in the sections that correspond to their respective objectives (i.e., text describing Sentinel and Evaluation wells).

Mound Site Plume Treatment System

Monitoring locations specific to the MSPTS are shown on Figure 3–27. Sampling and data evaluation protocols are summarized in Table 3–36. In addition to the monitoring locations shown, one well is monitored as a Sentinel well (see related text above), and several piezometers are present within the collection trench. Although the piezometers are no longer routinely monitored, they are retained for troubleshooting purposes. Six other monitoring wells were abandoned in 2008 as discussed in Section 3.1.1.2.

Table 3–36. RFLMA Sampling and Data Evaluation Protocols at MSPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
MOUND R1-0	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
MOUND R2-E	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
GS10	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D



Note: The intercept trench also captures water from a former 72-inch storm drain utility corridor (not shown) that previously emptied to South Walnut Creek (shown here as FC-4). This corridor runs from south to north, approximately parallel to the dominant trend of FC-5 shown here. It was backfilled and tied into the western portion of the intercept trench during Site closure activities. See the 2006 Annual Report (2007e) for additional discussion, and subsequent sections of this 2008 report for water-quality updates.

Figure 3–27. RFLMA MSPTS Monitoring Locations

Data Evaluation

All MSPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2008. Results are provided in Appendix B and are discussed in Section 3.1.5.3.

East Trenches Plume Treatment System

Monitoring locations specific to the ETPTS are shown on Figure 3–28. Sampling and data evaluation protocols are summarized in Table 3–37. In addition to the monitoring locations shown, several monitoring wells are present, and several piezometers are present within the collection trench. Each of the wells is monitored as a Sentinel well (see related text above). Although the piezometers are no longer routinely monitored, they are retained for troubleshooting purposes.

Table 3–37. RFLMA Sampling and Data Evaluation Protocols at ETPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
ET INFLUENT	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
ET EFFLUENT	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
POM2	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D

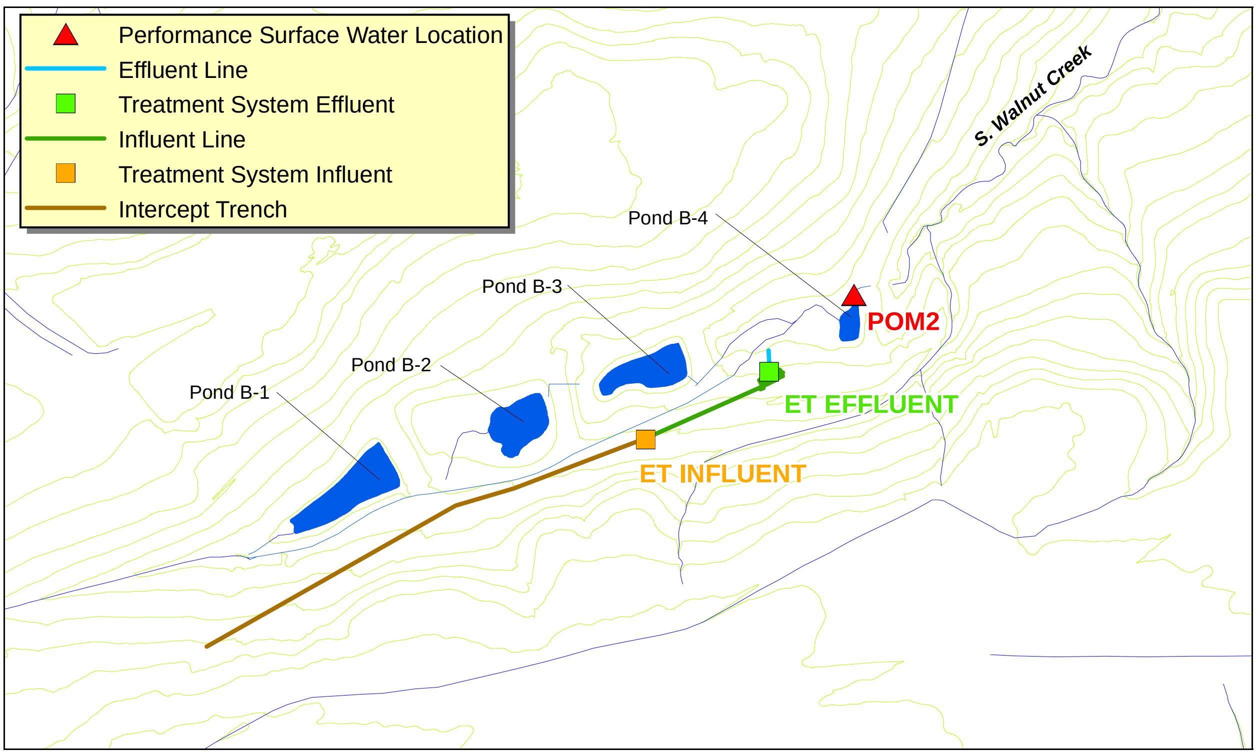


Figure 3–28. RFLMA ETPTS Monitoring Locations

Data Evaluation

All ETPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2008. Results are provided in Appendix B and are discussed in Section 3.1.5.3.

Solar Ponds Plume Treatment System

Monitoring locations specific to the SPPTS are presented on Figure 3–29. Sampling and data evaluation protocols are summarized in Table 3–38. In addition to the monitoring locations shown, several monitoring wells are present, and several piezometers are present within the collection trench. The wells are monitored as either Sentinel wells or Evaluation wells (see related text above). Although the piezometers are no longer routinely monitored, they are retained for troubleshooting purposes.

Table 3–38. RFLMA Sampling and Data Evaluation Protocols at SPPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
SPIN	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D
SPPMM01	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D
GS13	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D

Notes: [a]Samples collected for U at GS13 are typically flow-paced, unfiltered, and analyzed for U isotopes; however, if desired they may be collected as grab samples and field-filtered. U data at GS13 support other monitoring objectives that are not addressed here.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

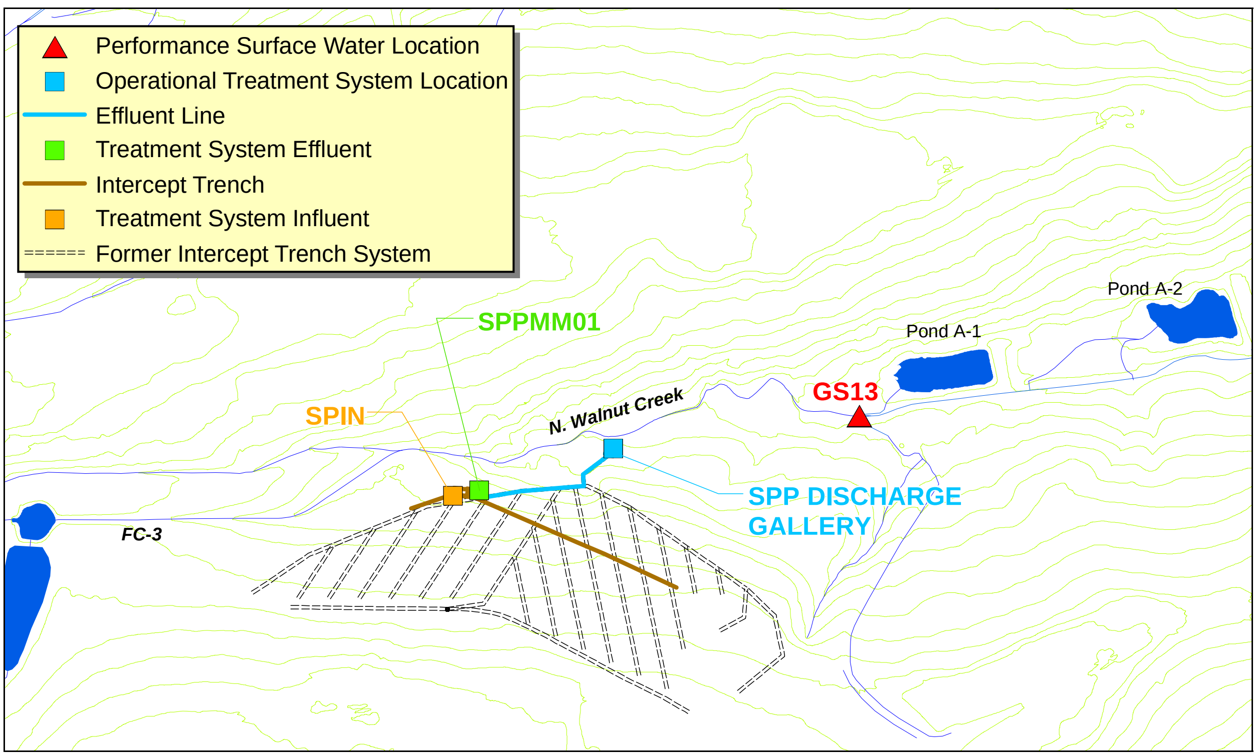


Figure 3–29. RFLMA SPPTS Monitoring Locations

Data Evaluation

All SPPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2008. The SPP Discharge Gallery (DG) was also sampled per the RFSOG. All SPPTS locations plus additional locations related to system operation and performance were also monitored to support an evaluation of the effects of Phase I improvements to the SPPTS (see Section 2.5.3) and to support WQCC discussions (Section 2.2). Results are included in Appendix B; see Section 3.1.5.3 for discussion.

PLF Treatment System

Water monitoring locations for the PLF are shown on Figure 3–23. The general groundwater monitoring requirements deal specifically with the RCRA wells and are discussed in detail in Section 3.1.2.8. Details regarding surface-water and treatment system monitoring are provided below.

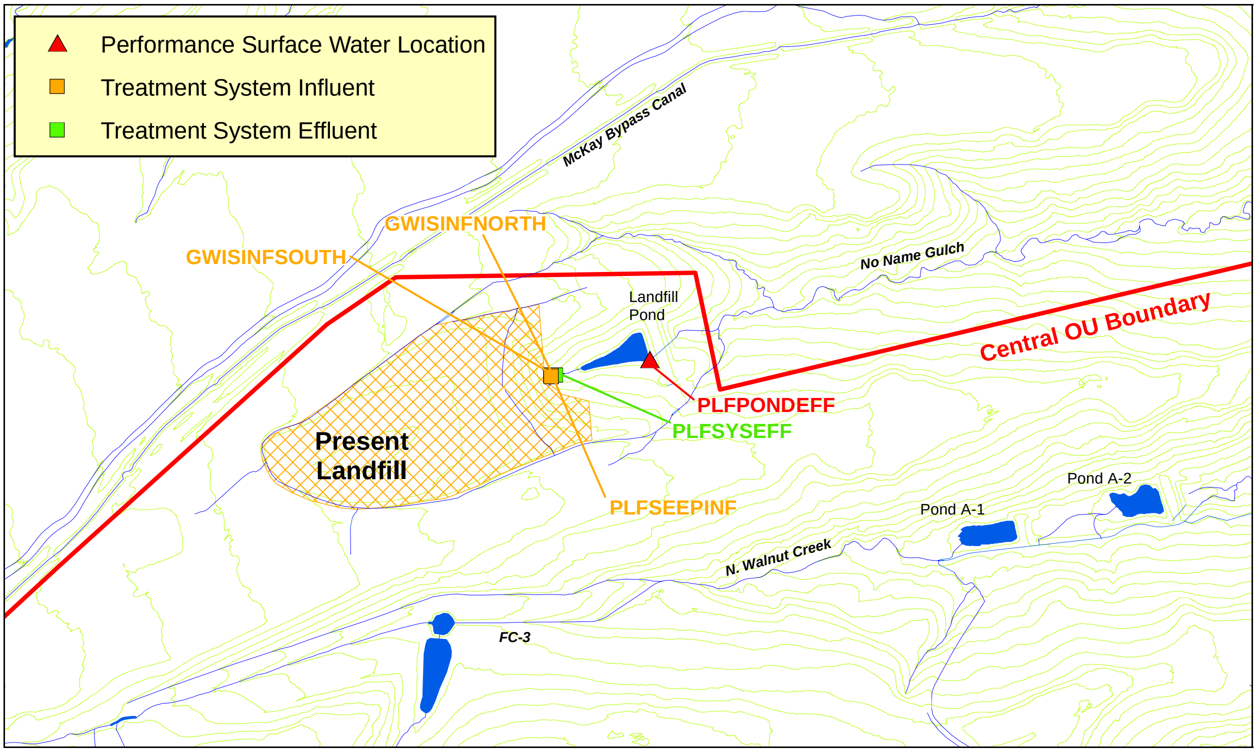
As part of PLF closure, a passive seep interception and treatment system was installed to treat landfill seep water and GWIS water. There are three sources of influent to the treatment system: two GWIS pipes and the PLF seep. Effluent for the treatment system eventually flows to the Landfill Pond. This section presents the monitoring data for the treatment system effluent as well as the Landfill Pond if the treatment system effluent exceeds surface-water standards. Details regarding PLFTS monitoring can be found in the PLF M&M Plan.

Monitoring locations for the PLFTS are shown on Figure 3–30. Sampling and data evaluation protocols are summarized in Table 3–39. As of December 21, 2007, collection of samples at the GWIS locations (GWISINFNORTH and GWISINFSOUTH) has been discontinued. This action has been taken subsequent to the consultative process in accordance with the Groundwater Treatment Systems flowchart (Appendix D) and documented in Contact Record 2007-08 (Appendix G).

Table 3–39. Sampling and Data Evaluation Protocols at PLFTS Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes	Data Evaluation
GWISINFNORTH	Northern GWIS influent to the treatment system	Discontinued	VOCs, isotopic U, total and dissolved metals, nitrate	See Figure 11 in Appendix D
GWISINFSOUTH	Southern GWIS influent to the treatment system	Discontinued	VOCs, isotopic U, total and dissolved metals, nitrate	See Figure 11 in Appendix D
PLFSEEPINF	Landfill seep influent to the treatment system	Quarterly grabs	VOCs, isotopic U, total and dissolved metals	See Figure 11 in Appendix D
PLFSYSEFF	Effluent from the treatment system	Quarterly grabs	VOCs, isotopic U, total and dissolved metals, SVOCs	See Figure 11 in Appendix D
PLFPONDEFF	Landfill Pond at the downstream (east) end	As needed; triggered by data evaluation	As needed; determined by decision rule	See Figure 11 in Appendix D

Note: Nitrate is analyzed as nitrate+nitrite as nitrogen. GWISINFNORTH and GWISINFSOUTH may still be periodically sampled for investigative purposes only.



Note: PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface-water monitoring location.

Figure 3–30. PLFTS Monitoring Locations

Data Evaluation

Analytical results for the treatment system effluent (PLFSYSEFF) are compared to the appropriate surface-water standards listed in Table 1 of RFLMA Attachment 2. Table 3–40 lists the sample results that were greater than the applicable surface-water standard in CY 2008.

Table 3–40. PLFTS Effluent (PLFSYSEFF): Summary of CY 2008 Grab Sampling Analytical Results Exceeding RFLMA Surface-Water Standards

Analyte	Sample Date	Result	Units	RFLMA Standard	Basis for Standard[a]
Cadmium, dissolved	5/7/08	1.9	µg/L	1.5	TVS[b]
Selenium	5/7/08	34.8	µg/L	4.6	AL
	7/9/08	13.0	µg/L	4.6	AL
	10/14/08	11.7	µg/L	4.6	AL
Silver, dissolved	1/23/08	1.1	µg/L	0.6 (PQL = 1.0)	TVS
Vinyl chloride	7/9/08	0.374	µg/L	0.023 (PQL = 0.2)	W+F
	10/14/08	0.255	µg/L	0.023 (PQL = 0.2)	W+F

Note: [a]Basis acronyms: TVS = Table Value Standard; W+F = Water plus Fish; AL = Aquatic Life. [b]Table value standards for metals are based on a toxicity equation which uses a hardness value of 143 mg/L. Whenever the PQL for a pollutant is higher (less stringent) than a standard or temporary modification, “less than” the PQL will be used as the compliance threshold.

For all analytes listed in Table 3–40, three consecutive months with results greater than the standard were not observed and sampling of the Landfill Pond was not triggered.

3.1.2.11 Pre-Discharge Monitoring

This monitoring objective deals with pre-discharge sampling of Ponds A-4, B-5, and C-2, or any other upstream pond functioning as a terminal pond, as a best management practice to indicate compliance with surface water-quality standards (see Table 1 of RFLMA Attachment 2) at the downstream POCs. Pre-discharge samples are collected at Ponds A-4, B-5, and C-2 on North Walnut Creek, South Walnut Creek, and Woman Creek, respectively. These locations are shown on Figure 3–31. Sampling and data evaluation protocols are summarized in Table 3–41.

Table 3–41. Sampling and Data Evaluation Protocols at Pre-Discharge Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes	Data Evaluation
A4 POND	Pond A-4 at east end of pond near outlet works	Prior to discharge	Pu, Am, isotopic U[a], nitrate	Consultation with regulators prior to discharge
B5 POND	Pond B-5 at east end of pond near outlet works	Prior to discharge	Pu, Am, isotopic U, nitrate	Consultation with regulators prior to discharge
C2 POND	Pond C-2 at east end of pond near outlet works	Prior to discharge	Pu, Am, isotopic U	Consultation with regulators prior to discharge

Notes: [a]Isotopes U-233,234; U-235; U-238.
Nitrate is analyzed as nitrate+nitrite; the nitrate+nitrite result is conservatively compared to the nitrate standard only.

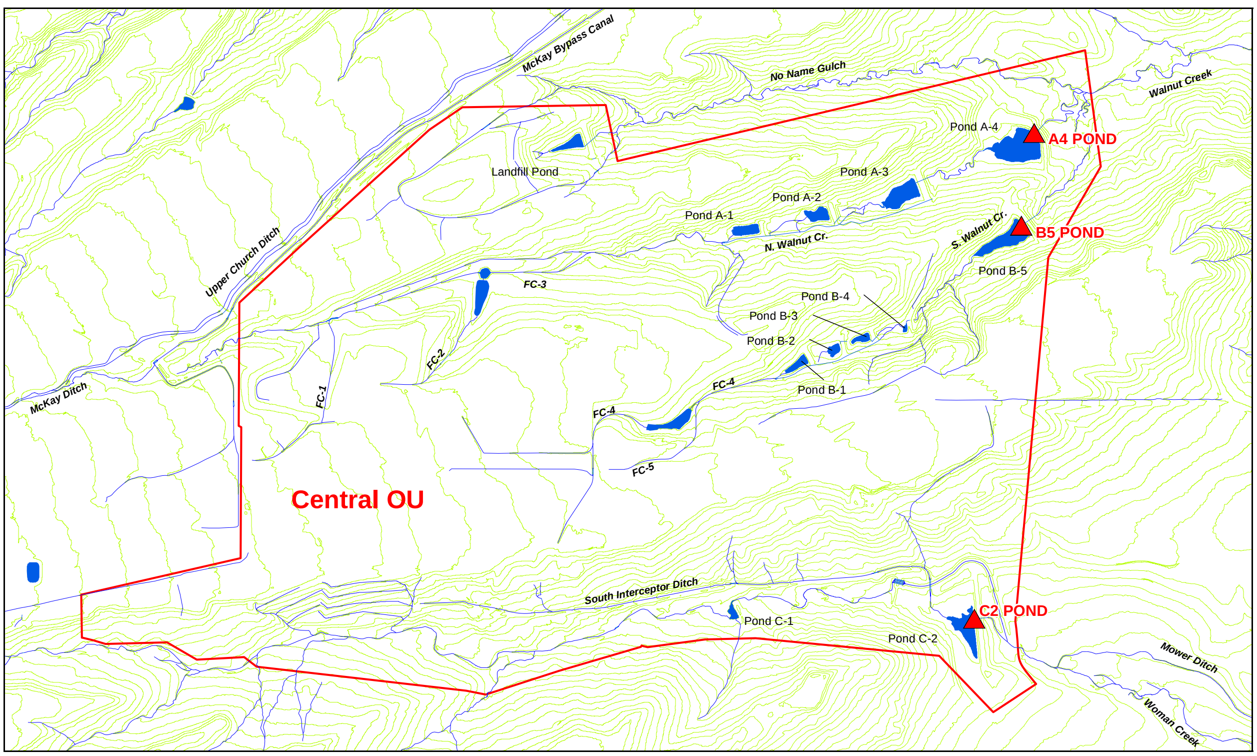


Figure 3–31. Pre-Discharge Sampling Locations

Data Evaluation

During CY 2008, pre-discharge samples were collected at Ponds A-4, B-5, and C-2 to facilitate annual valve exercise. All pre-discharge data suggested acceptable water quality. By design, a valve exercise results in a small amount of water being discharged through the outlet, but not enough water to reach the downstream POC monitoring locations. As such, A-4 and B-5 were successfully exercised with no water reaching the downstream POCs. Pond C-2 was not exercised due to a broken valve handle; C-2 will be exercised during CY 2009.

3.1.3 Rocky Flats Hydrology

The following section provides information for all automated surface-water monitoring and precipitation gage locations at the Site that operated during CY 2008. For locations with continuous flow measurement, graphical discharge summaries are provided. Graphical summaries are also provided for all precipitation gage locations. Numerical discharge and precipitation values are included in the tables in Appendix A.

Groundwater hydrology is also addressed. This includes a discussion of groundwater levels in various areas of interest via the preparation of hydrographs and potentiometric surface maps. Flow velocities are also calculated. Hydrographs for monitoring wells are included in Appendix A.

3.1.3.1 General Hydrologic Setting

Streams and seeps at the Site are largely ephemeral, with stream reaches gaining or losing flow, depending on the season and precipitation amounts. Surface-water flow across the Site is primarily from west to east, with three major drainages traversing the Site. Fourteen ponds (plus several small stock ponds) collect surface-water runoff, although only 12 ponds are within the COU and maintained by LM. The Site drainages and ponds, including their respective pertinence to this report, are described below and shown on Figure 3–32.

In September 2008, the Site began the reconfiguration (breaching) of several of the dams in sections of North and South Walnut Creeks. The reconfiguration eliminates the dams from ongoing monitoring and maintenance requirements and returns the stream reaches to a more natural system, while preserving existing wetlands and habitat. The project was completed in March 2008 (see Section 2.3).

The major stream drainages leading out of the Refuge, from north to south, are Rock Creek, Walnut Creek, and Woman Creek. North Walnut Creek flows through the A-Series Ponds and South Walnut Creek flows through the B-Series Ponds; both are tributaries to Walnut Creek. The hydrologic routing diagram (as of December 31, 2008) for the locations included in this report is shown on Figure 3–33.

The groundwater hydrology is generally characterized by relatively thin, shallow saturated materials (in the COU, typically on the order of a few dozen feet thick and less than 50 feet deep). This shallow saturated interval occurs within the unconsolidated Rocky Flats Alluvium, hillslope colluvium, valley-fill alluvium, artificial fill, and the weathered portion of the underlying bedrock. Collectively, these materials are referred to as the upper hydrostratigraphic